THE JOURNAL OF GAS LIGHTING
WATER SUPPLY & SANITARY IMPROVEMENT

VOL. LIV. No. 1366.] LONDON, JULY 16, 1889. [41ST YEAR. Price 6d.

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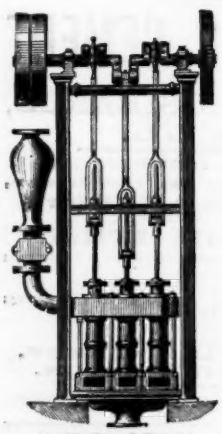

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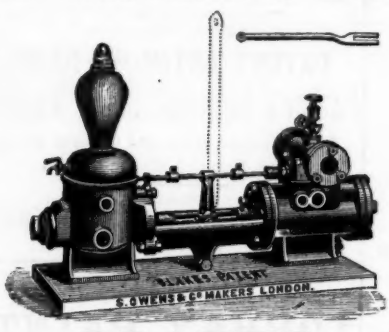

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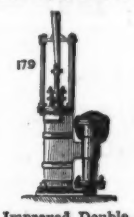

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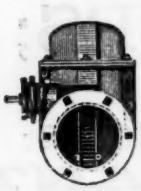

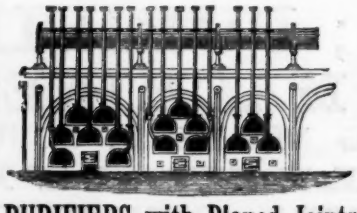

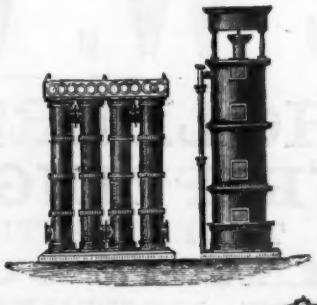

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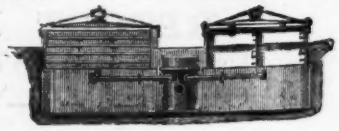

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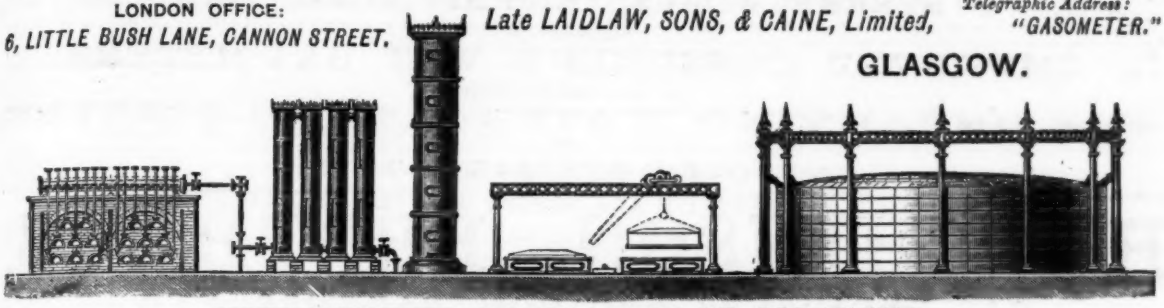

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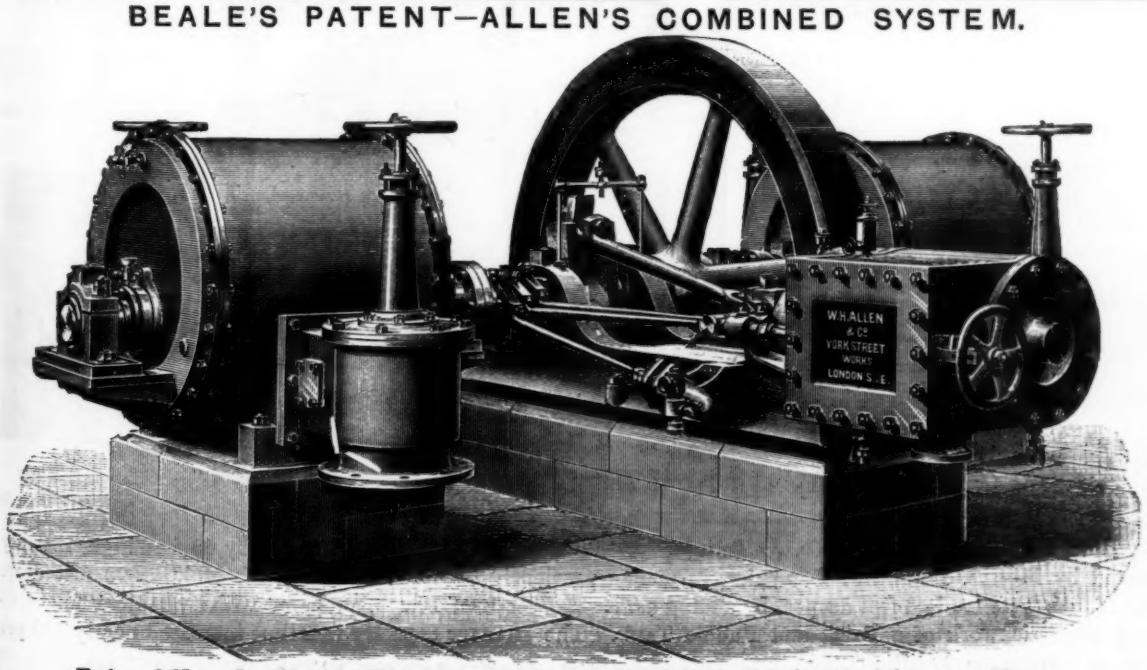

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SPENT LIMES NO LONGER WASTE PRODUCTS!

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MOST EFFECTIVELY AND *ECONOMICALLY RESTORES* LIME WASTES CONTINUOUSLY.

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Further particulars may be had on application to A. F. Wilson, Esq., Assoc. M. Inst. C.E., 12, Walbrook, London, E.C., Agent for London; J. E. Fisher, Esq., Stourbridge, Agent for the rest of England, Wales, and Ireland; or to the Patentee—

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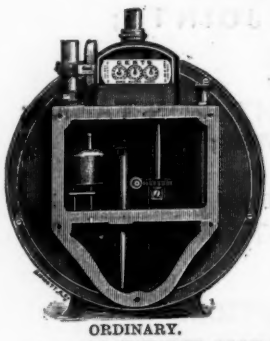
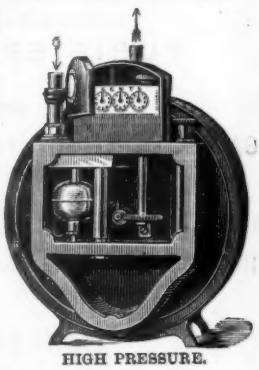


ORDINARY.



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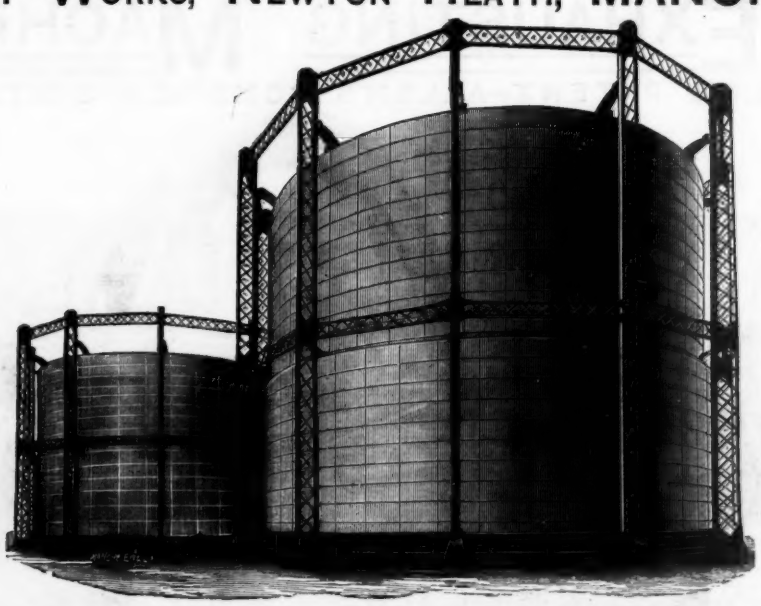

Illustration showing view of two Telescope Gasholders, each 65 feet diameter by 48 feet high, recently erected by Messrs. R. and J. Dempster, in Tanks previously occupied by Single-lift Holders 20 feet deep. The Tanks were made 4 feet deeper, by adding a Tier of Cast-Iron Plates, prepared with suitable Flanges, to meet the Brickwork of a Brick and Puddle Tank. The storeage capacity was thus increased nearly 150 per cent. at comparatively little outlay.

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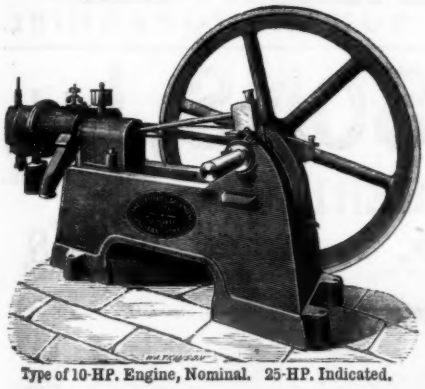

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Testimonial from Mr. JAMES MOON, Engineer to the Filey Gas-Works.

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GENTLEMEN,—We have been using one of your Gas-Engines on our Works for about four months, and I have pleasure in saying that it does its work in a very satisfactory manner. The engine is half-horse power, steady in all its movements, and, with ordinary care, will drive the exhaust apparatus at an even gauge.—I remain, Yours respectfully,

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GASHOLDERS, Telescope and Single-Lift, any size. Some of the largest in the Kingdom erected by this Firm are giving the highest satisfaction.

PLANS and SPECIFICATIONS furnished for **Extensions** and **Enlargement** of existing **Works,** adapting them to the most **Improved** and **Modern Principle** of **Gas Manufacture.**

PURIFIERS, CONDENSERS, WASHERS, ENGINES and EXHAUSTERS, STATION METERS and GOVERNORS, manufactured and erected.

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Price Lists, Specifications, and Estimates provided for any work appertaining to Gas Lighting, from the Retort-House to the Drawing-Room.

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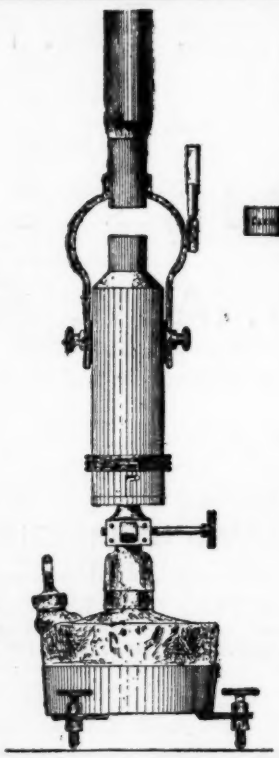

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STANDARD LAMP.

IMPROVED TYPE.

AS USED BY

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ROSE MOUNT GAS ENGINEERING WORKS,

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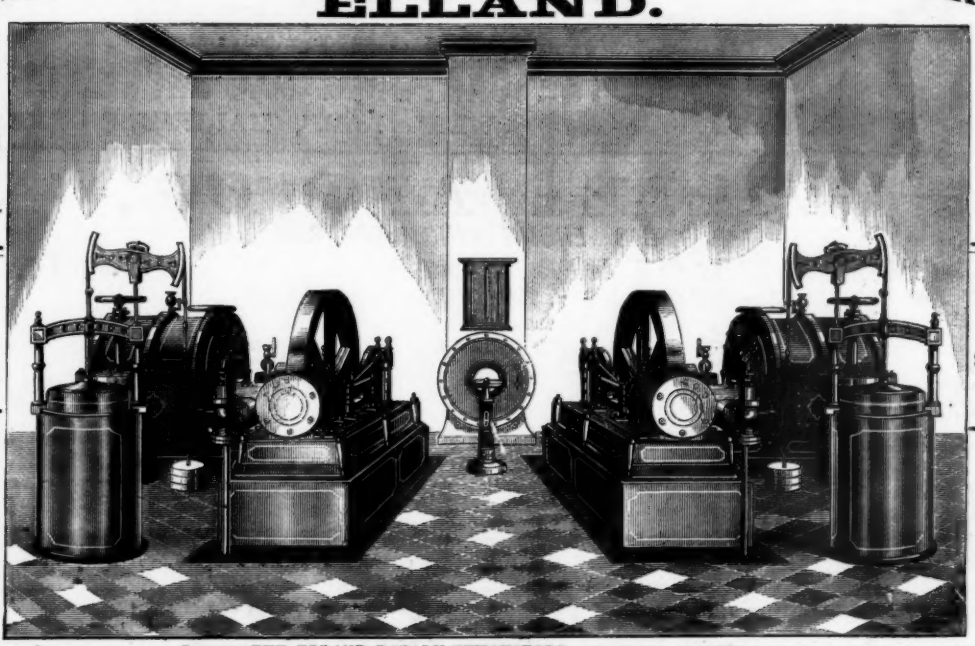

No. 5.
Screw Valve.

NO SLIP.

NO OSCILLATION

NO HIGH SPEED

STEADY GAUGE.

No. 3.
Screw Valve.

No. 6.
Disc Valve.

THE ABOVE IS AN ILLUSTRATION OF A PAIR OF THE ELLAND ROTARY EXHAUSTERS ERECTED BY US AT WIGAN, EACH OF WHICH ARE CAPABLE OF PASSING 80,000 CUBIC FEET OF GAS PER HOUR.

Makers of every other description of Gas Plant, including Retorts, Retort Mountings, Condensers, Washers, Tar and Liquor Separators, Scrubbers, Purifiers, Gasholders any size, Patent Centre-Valves, Four-Way Valves, Rack, Screw, and other Valves.

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SQUARE

STATION METERS

OF

Elegant Design

AND

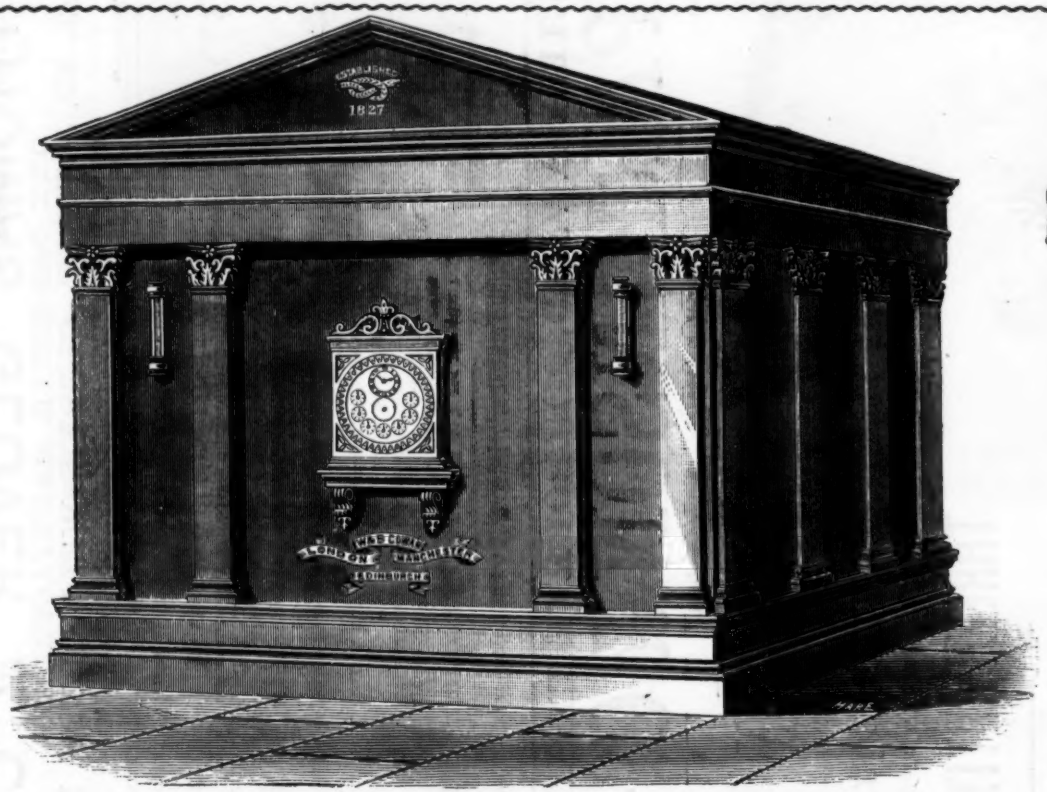
Improved Construction,

WITH

Planed Joints

AND ALL

Modern Improvements.



SQUARE STATION METER—B Design.
OTHER DESIGNS FURNISHED ON APPLICATION.

ROUND

STATION METERS

IN

All Sizes,

UP TO AND INCLUDING

30,000 Cubic Feet per Hour.

Prices and all Particulars on application.

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The latter being the Highest Medal awarded for Dry Gas-Meters by the Imperial Commissioners for the Universal Exhibition, Paris, 1867.
Since then we have not Exhibited for Prizes.

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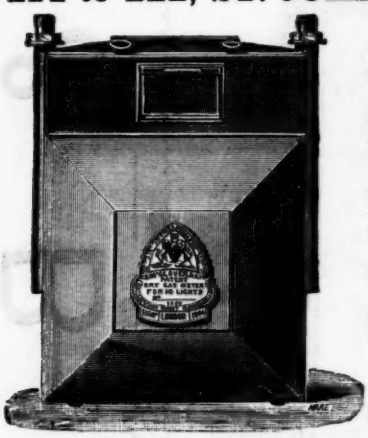

1st—Are a remedy for all the defects of Wet Meters
2nd—Are suitable for all climates, whether hot or cold.
3rd—Incur no loss of Gas by Evaporation.
4th—Cannot become fixed by frost, however severe.
5th—Are the most accurate & unvarying measurers of Gas.
6th—Prevent jumping or unexpected extinction of the Lights.
7th—May be fixed either above or below the level of the Lights.
8th—Cannot be tampered with without visibly damaging the outer case.
9th—Will last much longer than Wet Meters.
10th—Will not cost more than one-half for repair that Wet or Water Meters do.
Are upheld for five years without charge.

Meters fitted with Grey's Index or Harding's Counter.

HIGHEST AWARD, MELBOURNE EXHIBITION.

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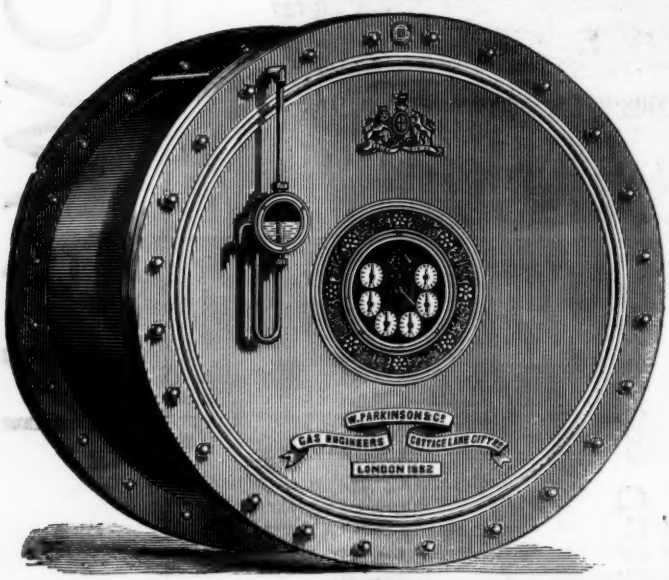

STATION METERS

IN

ROUND or SQUARE TANKS,

FITTED WITH PATENT

THREE-PARTITION DRUMS

MORE THAN

250 STATION METERS,

Varying in size from 1200 to 200,000 cubic feet per hour, have been sold, fitted with

THREE-PARTITION DRUMS,

Since their introduction three years since.

ROUND METERS as above are kept in Stock in all Sizes, ready to send away at the shortest notice. Compact, portable, and very easily fixed. An Improved Overflow Water-line Regulator fitted to every Meter.

PRICES VERY MODERATE.

DURABILITY UNEQUALLED. SOME HAVE BEEN IN CONSTANT USE FOR OVER 60 YEARS.

[See also Advt., p. 148.

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THE JOURNAL OF GAS LIGHTING,
WATER SUPPLY, & SANITARY IMPROVEMENT.

TUESDAY, JULY 16, 1889.

A PECULIAR PRECEDENT.

A VERY significant commentary upon the remarks of those who wonder how it is that English Gas Companies are prevented from adding electric lighting to their ordinary business, if they should deem such action desirable, is supplied by the proceedings in the House of Lords, reported elsewhere, in the matter of the Belgrano (Buenos Ayres) Gas Company's Bill. This measure had passed the Commons; but when it came under the purview of the Earl of Morley, the Chairman of Committees of the House of Lords, such objection was taken to it, that the mover of the second reading—Lord Herschell—was obliged to make a special explanation in regard to it. Yet the Bill was of a particularly simple and, as it may appear, harmless character. The Belgrano Company, by their Memorandum of Association, were originally formed for the purpose of supplying gas in Buenos Ayres; but the great majority of the shareholders desired so to modify the Memorandum as to enable the Company to undertake electric lighting in addition to gas. Objection was taken that such a change in the objects of the Company might be distasteful to a minority of the proprietors; and while this argument appeared to have any real support from the facts, Lord Herschell would not take charge of the Bill. Inquiries showed, however, that of 220 shareholders, with 14,000 shares, there were 218 shareholders, with 13,964 shares, agreeable to the proposal; thus leaving only two proprietors and 36 shares to be accounted for. One of these shareholders has recently died; and the other having been abroad, his consent could not be formally obtained. As Lord Herschell remarked, substantially it might be taken that the whole of the shareholders desired the alteration. The change could only be made by Act of Parliament, instead of by the simpler process of dissolution and reincorporation with the desired alteration of constitution, because it was important to maintain the continuity of existence of the Company in view of the preservation of their concession. The matter appears as clear as anything of the kind can possibly be; but, notwithstanding all that Lord Herschell could advance, the Earl of Morley stood firm, and argued that no case had been made out for the Bill. Upon general principles, it was remarked that there is great danger in touching the Memorandum of Association of a Company; and very special circumstances would have to be adduced before the House of Lords would sanction such a course. It was admitted that all the shareholders were consenting parties to the scheme; but the Chairman of Committees refused to concede the proposition that the wishes of shareholders are alone to be consulted in such a case. Mortgagees and creditors are equally interested in the matter, although no opportunity is afforded them for expressing their opinion of what directors may propose and shareholders accept. Besides, there is the interest of the general public. In the present case, there is stated to be already in Belgrano an Electric Lighting Company which might have been established upon the faith that the local Gas Company had no power to supply electric lighting. The Chairman of Committees carried the Lord Chancellor with him in his argument; Lord Halsbury observing, with the directness that some great lawyers can assume when they please, and which reconciles one to the statement that law is organized common sense, that "the case simply was that the Company now "wanted to go into a different business, but he had heard "nothing that would justify any alteration in the rules "hitherto observed." A division was taken, and the motion rejected by a majority of 21. The result did not satisfy Lord Herschell, who has since obtained the appointment of a Select Committee to join with a Committee of the House of Commons to consider and report under what circumstances, or upon what conditions, if any, Private Bills altering the terms of the Memorandum of Association of Companies ought to be allowed to pass.

It is only right that a matter of so much importance to the trading and investing community as that to which we have referred should be settled upon general and intelligible lines; so that a Company may learn, at less cost that that of an abortive Bill in Parliament, how to shape their policy in regard to alterations of constitution. The incident is instructive in respect of its subject-matter, as already remarked; for here we have an authoritative statement defining gas supply and electric lighting to be distinct businesses, notwithstanding their community of result in the fact of lighting. We are not sufficiently acquainted with the circumstances to enable us to say, on the merits, whether the aim of the Belgrano Gas Company in this case was good or bad. All the same, and notwithstanding the somewhat hair-splitting objections of the Earl of Morley, we should be disposed to think, in a general way, that a course of action deliberately adopted by substantially the whole body of shareholders of a joint-stock Company ought to be permitted to them. It is fair enough, so far as the argument goes, to say that other people are affected by an alteration in the object of a trading Company; but Companies, whether limited or statutory, do every day

make novel departures more or less cognate to their main undertakings, and nobody is injured thereby. Railway Companies, for example, do all sorts of things now-a-days that never entered into the schemes of their projectors; and everybody is satisfied. The fact that we do not believe, as a general thing, in Gas Companies taking up electric lighting does not prevent us from holding that a Gas Company is deserving of consideration whose shareholders, one and all, after having been fairly asked, agree upon such a course. Essentially this is the same thing as the formation of a Gas and Electric Light Company with undivided capital; and we should never dream of raising any objection to an honest venture of this duplex kind. On the whole, therefore, the Belgrano Company seem to have been hardly dealt with by the House of Lords; but they can probably afford to wait a year, when Lord Herschell's Committee will have cleared the way for further action. If there should still be no means of doing what the Company desire, there will, after all, be no great hardship in sticking to gas.

STOKERS AND OTHER GAS-WORKS HANDS.

The gas stokers' agitation is progressing to its termination. The Crystal Palace Company's men have agreed to the terms proposed by the Directors; but the Commercial Company's men have not yet come to a settlement with Mr. H. E. Jones, who has made a very reasonable offer. The Commercial hands appear to want a greater concession than those of any other Company in London; but we doubt not that matters will be satisfactorily arranged in due time. It is worthy of notice that the men who have finished their own negotiations have held a mass meeting, at which the amplest acknowledgment was made of the manner their requests have been dealt with by their employers. There is now a question respecting the condition of the other gas-works hands who, like the retort-house men, have been accustomed hitherto to divide the day and night into two shifts. These are the valvemen, engine-drivers, &c., whose numbers bear but a small proportion to those of the stokers. These men, necessarily steady, faithful, and removed from intimate association with the mass of less responsible labourers, have a reasonable claim on the consideration of their employers. It is to be hoped that it will never be said that the Gas Directors of London yielded to clamour and combination what they refused to silent merit. All that we are concerned to show at present is that the grant to the retort-house men of the eight-hour system has materially altered the positions of other workmen in the London gas factories; and it is sufficient to leave this matter in the care of the Engineers. To complete the movement which the stokers began will not cost an appreciable amount of money; and in any case we do not believe the shareholders or the public will begrudge the small sacrifice necessitated for placing all grades of their servants upon an equally satisfactory footing.

A CRITICISM OF CORPORATION GAS ADMINISTRATION.

Intelligent outside criticism of gas-works administration is always as welcome as its reverse is irritating, and the fact of the latter being much more common than the former makes this the more grateful when we can discover it. There recently appeared in the *Engineer* a carefully-written article upon the condition and prospects of gas supply in the United Kingdom, based upon information derived from "Field's Analysis," which may be commended to our readers as a good example of the criticism which is instructive and helpful. It ranges over a good many points, from an attempt to discover in the statistics of the growth of gas consumption in London some indication of the progress of electric lighting, down to the troubles of the Gas Companies in the matter of testing for illuminating power. The first labour of the impartial critic is not very successful, for he no sooner gets evidence in the figures relating to some of the Companies of a "decremental "rate of increase," which he thinks may be due to the success of electric lighting in some districts, than he has to admit the force of other evidence of a contradictory tendency. Upon the vexed question of the deficiencies of illuminating power, in respect of which certain Companies have been subjected to legal proceedings, the writer fairly admits the difficulty of the tests, depending as they do upon a discredited standard, and concedes that the average results are favourable to the Companies. He also brings out the interesting circumstance that year by year "the price of gas falls, except—oddly enough—in the "case of the Provincial Corporations. In the eight corpora- "tion undertakings specified, the average charge for gas last "year was higher than in 1885, a fact which we may attribute "to the tendency to employ gas profits in aid of local rates; "thus, as we have intimated on a previous occasion, creating "a coal tax in another form." After showing how this result is ascertained, the writer goes on to remark that "gas in London "was cheaper in 1888 than in 1885 by 3d. per 1000 cubic feet, "and in the suburbs by 2¾d. The reduction among the "ten English Companies was ¾d. per 1000 cubic feet, while "the eight English Corporation undertakings showed a rise "of a fifth of a penny." Nothing that we have ever advanced to support the assertion that corporation gas administration is on the whole bad for consumers, is more damaging than this plain statement from a critic who looks at the subject from an outside standpoint. It remains for the advocates of corporation gas management to show that this result is counterbalanced by other considerations—by proving, first, that in the towns implicated the rates are lower than they would have been but for the application of gas profits to municipal purposes; secondly, that rates are lower in these towns than in comparable places where the gas profits are not so available; and, thirdly, that this system has benefited both gas consumer and ratepayer. To begin with, we may leave the third argument out of the question, and confine our case to the others. The discussion would be peculiarly timely just now, when the gas administration of the Manchester Corporation has been so severely attacked not merely on account of the consumers but also in the interest of the ratepayers.

A CONFERENCE ON RAILWAY RATES.

A conference has been held between representatives of the Railway Companies and of traders, for the discussion of the new railway traffic classification which has latterly aroused so much interest throughout the country. The meeting was convened upon the invitation of the Board of Trade, and might possibly have been more productive of good than it really was but for an initial misconception of its purpose. The Board of Trade have received such a mass of objections to the proposed new classification, that they thought it would be better for traders and railway officials to meet in various districts for the purpose of agreeing upon points of detail that now block the way, and thus leave the grave matters of principle to be decided upon broad lines. This meeting, however, after hearing an explanation of the views of the Board of Trade from Mr. Courtenay Boyle, seemed hardly to know what to do next. All the traders present were full of their own particular grievances, and railway experts were ready to talk to them; but it was recognized as impossible to go into matters of detail in such a meeting. Ultimately, therefore, the proceedings resolved themselves into talk round and about the subject. Sir John Harwood, of Manchester, made it a great point that such a system of classification and rating should be formulated that every trader in his own office could learn from a list what the charge would be for sending his goods any distance. It was pointed out, however, that this would in many instances cause hardship upon traders; and it was also fully explained, on behalf of the Railway Companies themselves, that a maximum statutory rate does not necessarily mean the same as a working rate. This is a point that we have already brought out in the Journal; and the analogy between the railway maximum rate and the Gas Company's maximum selling price is so exact, that one would scarcely think there could be any need for further explanations on this head. The Railway Companies naturally claim in this respect some liberty, which, it appears to us, Gas Companies should be the last to deny. If the Railway Companies are not to be trusted with a margin of rating power, by all means let this be proved to the Board of Trade. Otherwise it is difficult to avoid the suspicion that much of the present agitation on the subject of the new railway rates is superfluous.

THE POSITION OF CHIEF ENGINEER TO THE LONDON COUNTY COUNCIL.

The appointment by the County Council of London of a Chief Engineer at a salary of £1500 a year is an event that calls for some notice, especially with regard to the conditions attached to the office. Mr. Joseph Gordon, Borough Engineer and Surveyor of Leicester, has obtained the appointment; but in what we shall have to remark upon this subject we do not propose to discuss Mr. Gordon's fitness for the position, beyond observing that the admirable management of the town he is about to leave presages well for his conduct of the weighty duties he will have to discharge in London. We are more concerned with the conditions attached to the office of Municipal Engineer for London, as settled by the Council Council, from the point of view of those who are interested in the branch of the great profession to which Mr. Gordon belongs.

In the first place, it is to be observed that the Engineer to the County Council of London accepts, as the condition of his employment, the stated salary as excluding all prospect of pension or retiring allowance. Moreover, he holds office at the pleasure of his employers, and engages himself not to take any private practice. These stipulations must be regarded as signs of the times; and it is only necessary to refer to the example of Sir Joseph Bazalgette, Engineer to the late Metropolitan Board of Works, to point the difference between the old system and the new. Sir Joseph not only carried on an extensive and lucrative private practice, but he also retired on a liberal pension when the Metropolitan Board passed out of existence. He also enjoyed a higher salary; but this is not so much a question of principle, because there is nothing whatever to prevent the raising of Mr. Gordon's pay if his employers should in course of time consider him worthy of it. As it is, the Engineer is by far the highest paid official in the service of the Council; and one could hardly discuss the amount of his salary, seeing that it cannot be called unreasonable, without taking into consideration the remuneration and status of all his brother officers of the new dispensation. The most salient feature of the matter is the prohibition of private practice; and this condition, on the whole, is a good one. Either an engineer works for himself or for his employers. If he is very much run after by casual clients, he should set up as a consultant, which would not prevent his being retained as standing adviser by any corporation or company so desiring. A position as engineer to a great corporation is a splendid advertisement for a man who is open to outside engagements, and gives him an undue advantage over independent consultants. It also renders corporations more indifferent than they would otherwise be to the class of man whom they permanently employ. When a notorious man has the run of a connection through his salaried position, he indirectly starves out rising men. Of course, there are exceptions to the rule; but, on the whole, though we know we are not in agreement with many upon this subject, we are disposed to hold that salaried engineers should not do consulting work, but should be paid sufficient to keep them to their own particular appointments. Similarly with the question of pensions. A man's pay when in full work should discharge all liability; but this condition need not necessarily proscribe compensation for disturbance and injury not foreseen in the terms of the engagement. Independence is the prime necessity for both parties, combined with the due consideration of mutual obligations. The great difficulty in the case of a popular body served by permanent officials is to keep the latter in their place—up to it, but not beyond it; as it is equally the difficulty of the officials to maintain their positions without presuming upon them. The Metropolitan Board of Works was called an officer-ridden body; and the same may be said of the Corporation of the City of London at the present time. It remains to be seen whether the County Council will fare differently under their new system. If this succeeds, it will probably serve as the model for many other authorities, and may even invade Government Departments in course of time.

DESTRUCTION OF THE JOHNSTOWN (PENNSYLVANIA) GAS-WORKS.

The recent disaster in the Conemaugh Valley, Pennsylvania, affected a multiplicity of interests, as well as brought death to a hecatomb of victims; and a statement that has been made public relating to the arrangements now in progress for rebuilding the Johnstown Gas-Works will give our readers a vivid idea of the awfulness of the wreck that the bursting reservoir made of the once busy valley. The works were situated in the bottom of the ravine, immediately beside the stream, and, consequently, were exposed to the full force of the flood as it swept through the narrow valley. The station was completely demolished; nothing remaining in a waste of shingle, cumbered with trunks of trees, to show that the site was ever that of a gas-works, but the brick gasholder tanks, filled with sand, round the ragged edges of which stand two or three cast-iron bases of columns. The two gasholders were full when the flood reached the spot at 4 p.m. They were carried, with the guide-columns all standing, to the stone bridge which dammed back so much other wreckage, and finally collapsed among the ruins of the plant of the Cambria Iron Company, three-quarters of a mile from the gas-works. Of the three principal brick buildings, not a brick remains on or near the site. The retort-stack was razed to the level of the ash-pans, and all the fittings were scattered over several acres of ground. There was a water-gas plant on the works, all of which disappeared in a few moments; the oil-storeage tank, which would float, being afterwards discovered stranded in a meadow 23 miles down stream. The Superintendent of the Gas and Water Works (Mr. James Williams) was saved, but all the gas-works hands are gone. After all has been said, however, an eye-witness is probably correct in remarking that language fails to describe the scene of ruin, which must be visited to be fully realized.

Water and Sanitary Affairs.

Of Metropolis Water Bills it may be almost said they "come like shadows, so depart." This is singularly true of Bill "No. 3," introduced by Mr. O. V. Morgan, and backed by nine members of Parliament in addition to himself. Brought into the House of Commons last Friday week, and read a first time, it was withdrawn on Thursday, although it was down for a second reading to-morrow. As the Bill was only issued a week ago, its actual existence has been limited to the short span of three days. Of course, the prospect of carrying the measure in the present session was hopeless from the first; but its quick withdrawal raises the question why it was ever introduced. We can only suppose that it was intended to show what the County Council were prepared to do, if the necessary powers were granted to them. Perhaps if the Bill comes forward again in its present shape, the parties who are paying water-rates in the Metropolis will take notice of the latter part of clause 7, by which it is provided that, when the water supply, or any part of it, becomes the property of the County Council, the profits may be employed in reducing the charge to the consumers, "or, on "the vote of the Council in any year, in reducing the Metro-"politan consolidated rate." The disjunctive conjunction is significant. Supposing such a clause to pass into law, and the Council to be possessed of the supply, the payer of water-rates would have no guarantee against a transfer of water profits to an entirely different account. Water may thus be taxed to afford a revenue for a variety of purposes, including those permanent improvements which the Council profess to think should be paid for by the ground landlords and the owners of property. The tax on water thus imposed would be as objectionable in principle as a duty on coal. In all fairness, water profits should go in reduction of the charge for water; and this is what the public naturally expect. Another feature in the scheme is one which we apprehended last week. The project does not contemplate an enforced sale of the water undertakings to the County Council; but the voluntary and seemingly amicable character of the transaction is marred by an evident preparation for cutting down the Companies seriatim. Thus clause 3 of the Bill proposes that any of the Companies may sell to the Council "a part or the whole of their undertaking." The scheme differs in this respect from that which was brought forward some years ago by Lord Cross. That measure included all the Metropolitan Water Companies at once, and made no provision for subsequent fighting and coercing. A third element in Mr. O. V. Morgan's defunct Bill, and one which the ratepayer may be expected to scrutinize somewhat keenly should it again make its appearance, was that which gave the Council power to purchase by agreement, without any prescribed check as to the price to be paid. This is a part of the affair to which the Companies need make no objection. But it is a matter in regard to the Bill which is likely to prejudice its reception by Parliament. When Lord Cross brought forward his scheme of purchase in 1880, he showed exactly what was to be paid. No blind confidence was demanded; all was plainly set forth, and the bargain was completely specified. On all sides Mr. O. V. Morgan's Bill is open to objection. The water consumer is imperilled by the clause relative to the appropriation of the profits; the Companies will object to a plan whereby they may be laid open to an unequal and coercive competition; and the ratepayers may complain that they will be left at the mercy of the Council as to the terms of purchase. We do not expect that the Council will err on the side of liberality in dealing with the Water Companies; and yet, in one particular instance, they might choose to pay a high price, so as to get their foot within the circle. If ever a London Water Companies' Purchase Bill passes, it must be on settled and comprehensive terms. Mr. O. V. Morgan's Bill is crude and imperfect, and will need to be so changed as to become another measure altogether, if it is to get through Parliament.

The Gas Institute.

PROCEEDINGS AT THE TWENTY-SIXTH ANNUAL MEETING.

GEORGE GARNETT, Esq., M. Inst. C.E., PRESIDENT.

PAPERS AND DISCUSSIONS.

(*Concluded from p. 73.*)

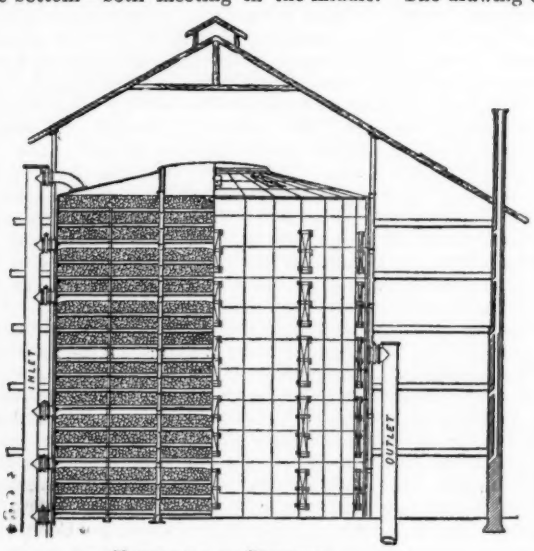
GAS PURIFIERS.

By GEORGE ANDERSON, C.E.

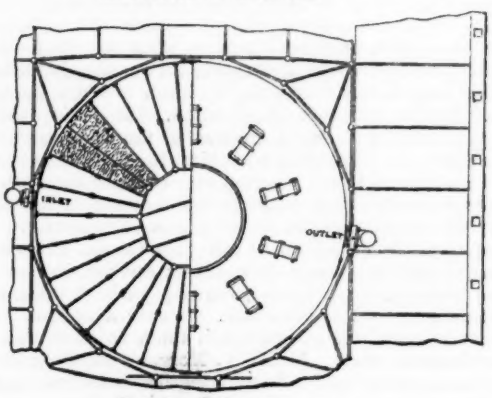
The mode of constructing and working purifiers, which forms the subject of this paper, was included in my patent of 1875, No. 2843. It may be remembered that about, and just before, that time there was considerable cry about sulphur in gas; and the London Companies and the Gas Referees were much taken up with that question, which also included that of nuisance from lime, by which, could they but use it, the Companies could have abated the quantity of sulphur remaining in the gas.

At works under my care I did purify with lime, producing very little smell; and, being engaged on the inquiry that took place at that time, I had to inquire into the then state of things. This inquiry brought out the fact that in most of the works the purifiers were decidedly too small. Gas was passing through the purifying material at the rate of from 5000 to 6000 cubic feet per foot of surface per twenty-four hours; whereas in my works it did not reach 2000 cubic feet. One engineer told me that in winter the rush of gas lifted the lime off the trays. One could see in an instant that satisfactory work could not he done under such circumstances; nor till enlarged purifiers were provided, for which there was very little space.

It occurred to me that the purifiers might be deepened and the area doubled on the same space, by dividing the stream of gas into two—one entering at the top, the other at the bottom—both meeting in the middle. The drawing on the wall illustrates what I mean. It represents a purifier 50 feet diameter by 60 feet high, which would contain above 70,000 cubic feet of oxide, divided into six parts of three layers each. The gas would be divided into two streams—one entering at the bottom, the other at the top—and passing to the middle, where it would pass off at the outlet. When the upper three and the lower three layers became thoroughly fouled, the second valve from the top, and the second from the bottom would be opened; and when these became fouled, then the third from the bottom and the third from the top would be opened. Of course, the principle need not be carried so far as into the three divisions described; it might be limited to one valve below and one above, which would require the purifier to be cleaned out oftener, but would still purify double the gas now done on the same area. A purifier of the size I have described would only be suitable for the very largest class of works; but the principle may be applied to purifiers of any desired smaller size.

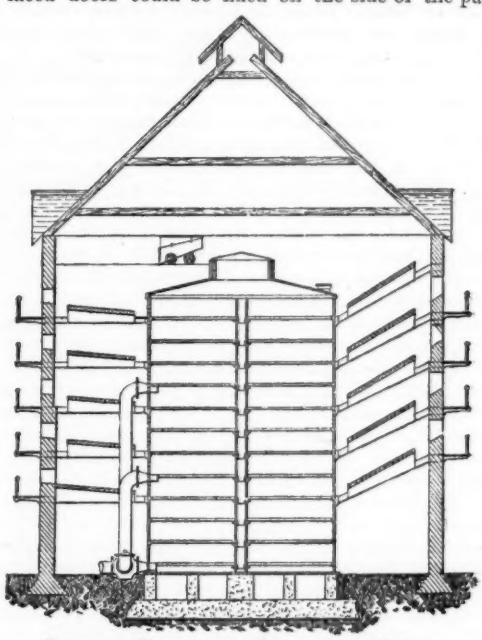


ELEVATION OF PURIFIER.



PLAN OF PURIFIER.

In working purifiers of the size I have described, both the charging and the discharging of them would involve variation from the present mode. The purifier might stand in a house wide enough to include the revivifying ground—containing a number of floors with ventilating shafts, in the thickness of the wall, to carry up all effluvia to the top of the house—and faced doors could be fixed on the side of the purifier,



PURIFIER HOUSE WITH REVIVIFYING FLOORS.

through which to receive and discharge the purifying material; or the foul material might be hoisted up through the centre by a steam-crane, tipped into waggons, and distributed over the floors, falling from one to another, till ready for charging into the purifier, when it could be hoisted into them. When the purifiers are very large, the moveable lid need not be more than 15 to 20 feet across. The rest of the top may be of the same strength as the sides, and may be flat or raised, as shown. In very large purifiers the internal construction for supporting the trays could be arranged so that a great portion of the trays and supports would remain in—only removing enough to give the men room to work. In the drawing shown, the lid water-lute is shown resting on a circle of columns, which would support the girders and form supports for the trays; but I need not encumber the paper with mechanical details, which practical men could arrange for themselves in the way most suitable to their local circumstances. What I wish to impress on you is the purifying of double the quantity of gas now purified on a given area.

The question then arises, What is now done by purifiers of the usual kind, and what, by parity of reasoning, could be done by those I have described? At a works of which I am engineer, we make a little over 200,000,000 cubic feet per annum. We have six purifiers, 36 feet by 18 feet by 6 feet—two of them for lime, and four for oxide. I wrote to the manager as to the number of purifiers charged per annum, and the cubical contents of oxide put into each. His answer was: "In the year 1888 we made 208,831,000 cubic feet of

gas. To purify this, six charges of oxide were required, each of which contained 2430 cubic feet of oxide. The total, therefore, was 14,580 cubic feet of oxide."

I will now apply these figures to one of my purifiers 50 feet diameter, divided in height into six compartments of oxide of three layers, each 2 feet in thickness. Cubical contents of oxide, 70,686 feet; hence, 14,580 : 208,831 :: 70,686 : 1,012,443,000 cubic feet.

Were the purifier reduced by one-third of its height—that is, each stream of gas passing through only 12 feet in depth—the quantity purified would be lessened to 675,962,000 cubic feet; or were the purifier reduced to one-third of its depth—that is, the lower inlet passing up through 6 feet of oxide, and the upper inlet passing down through 6 feet of oxide—the quantity would be still further reduced to 337,481,000 cubic feet. But if the purifier were to be reduced to only two compartments, as last mentioned, I think that each compartment might contain 8 feet in depth of oxide, which would increase the last figures 449,974,000 cubic feet.

Where the purifiers were of the depth first mentioned—that is, the gas passing up through 18 feet of oxide from the bottom, and down through 18 feet of oxide from the top, I would say that two such purifiers would suffice, because the first that is foulest need not be charged till you had a foul test where the gas had passed through one-third in depth of the second. That more gas can be purified on the same ground surface by the way I propose is self-evident.

So much as I have stated depends on the correctness of the figures of a year's working, which I received from the resident engineer of the works to which I have referred. I should state that in the works alluded to the gas is first passed through one of my washers, 24 feet long by 12 feet broad, next through a vertical scrubber, 15 feet diameter by about 25 feet high, and next through one of my five-brush scrubbers, each brush 10 feet long by 4 feet diameter. The whole of the ammonia, and much of the carbonic acid and sulphuretted hydrogen are removed from the gas before it enters the purifiers; and we also use Hill's process of introducing a percentage of air into the crude gas before the condenser.

The purifiers I have described are so different from those in common use that I am prepared for the dissent of gentlemen without feeling the slightest offence; but my defence is, while improvements have been made in almost every part of our apparatus, our purifiers remain the same as they were fifty years ago. They have only been augmented in size as consumption extended; and they are mere enlarged copies of their originals. When purifiers were first made, they were only 3 or 4 feet square; and the lids were of the full size of the purifiers. They have grown to be 20 to 30 feet square; the lids are of the same size, and have become so heavy that some ingenuity has been brought to bear on the best means of lifting them. While gas was sent into the purifiers loaded with strong-smelling impurities, there was some reason for having the lids as large as possible; but as that is now abolished in well-managed gas-works, the size of the lids, as well as the depth of the purifiers, may be varied without injury to the men.

Members of the Institute of twenty years' standing may remember that I have been an advocate of large purifying surface, and our Transactions prove this.* I am of the same opinion still; and I now suggest a mode by which their effective area may be increased without enlarging the area on which they stand.

I would not close this paper without drawing the attention of members to the valuable work being carried out by Mr. Valon, of Ramsgate, as published in the JOURNAL OF GAS LIGHTING recently. Mr. Valon is purifying gas by a mode by which the material lasts much longer, and is almost void of offensive smell when removed from the purifiers. I trust that some of the members in charge of large works may be inclined to follow on the same lines, and, I hope, obtain equally favourable results.

Discussion.

Mr. D. CLARKE (Ashton-under-Lyne) asked if Mr. Anderson found any increase of pressure by this mode of purification. There was also a statement in the paper about the lids not being the size of the purifiers. He was not quite clear as to what was meant by this. They wanted the lids to cover the purifiers; and he did not see how they could cover them unless they were the right size.

* See Transactions, 1874, pp. 51-66; also JOURNAL, Vol. XXIV., p. 16.

Mr. T. TRAVERS (Cork) said at his works they had a very satisfactory experience of the method which Mr. Anderson had described, and which he attributed in great measure to the system by which they injected the air into the purifiers. A good deal was said in the discussion of Mr. Valon's paper about the fall in illuminating power when air was admitted; but their experience at Cork was that, if air were injected regularly every hour, no ill-effects were produced. Of course, the quantity of air must be carefully regulated and kept in the proper proportion—not more injected at one period than another. To this they attributed the fact that the purifiers lasted so long a time. He found that the oxide when put out of action some two or three years ago contained 50 per cent. of sulphur. As an experiment he put some of this in again last summer, and worked it with a proper quantity of air, not exceeding 2 per cent.; and he found that the oxide had nearly 60 per cent. of sulphur. Still he worked it over again last summer, when the make of gas was at its least. In the winter he put in oxide containing 47 to 48 per cent.; and it had continued in use up to the present. He might say that at Cork they carried out in a great measure the theory which Mr. Anderson had enunciated.

The PRESIDENT desired publicly to thank Mr. Anderson for the efforts he had made from time to time with regard to gas purification. In his own works at Ryde, and in other works with which he was connected, he had been under a deep debt of gratitude to Mr. Anderson for the energetic way in which he had put forward his ideas in years gone by, both with regard to the large quantity of oxide to be used, and more especially with respect to the thickness and wet character of the lime when it was first put into the purifiers. When he first filled a purifier in accordance with Mr. Anderson's idea, he mixed the lime up almost like mortar; but instead of finding the pressure increased, the water (or the greater portion of it) was soon taken out, and it became a spongy mass. Since he had adopted the ideas which he had borrowed from Mr. Anderson, he had had no difficulty about pressure—in fact, it did not arise. If purifiers were filled in the proper way, whether with oxide or with lime, the pressure gave no trouble. He wished to say this much in justice to Mr. Anderson, and to let him know that his work had not all been labour in vain.

Mr. ANDERSON, in reply, said that the first question he was asked was, Did he find under this mode any increase of pressure? He must say that, although he took out this patent eight years ago, he had not pushed it. He simply patented it in connection with a number of other things, in case somebody else should be doing something of the same kind, and "take the wind out of his sails." He had, therefore, no experience of passing gas through a purifier with such a depth of oxide in it; but he had not proposed it without having considered the matter. He had taken the pressure at the inlet of the first purifier, and at the outlet of the fourth, when first using oxide 3 ft. 6 in. in each purifier; and the difference in pressure between the first and the last was about 2 inches. Of course, this would vary with the quantity of gas passed. He had another experience which Mr. John Somerville could confirm by his experience in Dublin. When he was there some years ago, he had a gasholder which was of very little use, in consequence of the magnitude of the works. It had an iron tank some 16 feet above the ground, and a few feet below; and it was disused as a gasholder. He converted it into an oxide purifier, and filled it with perhaps some 15 or 16 feet of oxide. He then found that, when he first charged the purifier, he could get the gas to pass through easily enough, and there was no trouble about the pressure. This was when the whole of the oxide was clean; but as it became foul, the pressure increased so enormously that it became impossible to pass gas through it. It rose from the normal pressure of about 20 inches up to about 6 or 7 feet; and the oxide really had to be taken out of the purifier before it was exhausted. Having this information in his mind, he thought the passing of gas down through 18 feet of oxide would not perhaps be too much, while it was clean; but when it got foul, he had means for letting the stream of gas in again lower down. The upper layer, which had been expended, would then lie by until the one below it was also expended, and so on until the whole was expended, and the purifier had to be cleared out. He would not advise any one to begin with such a great depth at once. He was quite confident that anyone confined for purifying space might put a double purifier with a stream of gas coming in at the top and another at the bottom (which there would be

no difficulty in); and by that means he would double his purifying surface. As to the fact that the vessel could not be covered unless the lid were the same size, that again was one of those matters which only required to be explained. The top of the purifier formed part of the permanent body of the vessel, and the lid was only that portion which showed open; and he adopted that plan for this reason. In large purifiers, it was a matter of considerable difficulty to lift the lids without mechanical appliances; and he thought the less one had to have recourse to appliances that cost money, time, and trouble, the better. There was no necessity for the lid being the same size as the purifier; and therefore he curtailed it, on the same principle that one did not make an opening into a room as large as the whole side of the room, but only had a door large enough to go in and out. Mr. Travers said he found no difference in the illuminating power; but he believed that was because he was very careful. He had two jets burning constantly before the man who had charge of the engines; and they were regulated to burn the same height of flame when the gas made and that sent out to the public was of the same quality. Therefore, if anything took place, such as too much air being admitted, down went the height of the flame, which was noticed in an instant, and might be attended to. He would also say that Mr. Travers was under very critical and strict supervision. His gas was tested by the Corporation tester daily; and if anything went wrong, he would find it out very quickly to his disadvantage. But when he went across there, he (Mr. Anderson) did not learn that the gas was ever found fault with. Sometimes it was half a candle below, or half a candle above the Corporation test; but the whole thing was working very harmoniously. He also referred to the care exercised in the injection of air. With regard to the injection of air, he (Mr. Anderson) found a number of people trying that; and his opinion was that it might be done successfully or unsuccessfully. It depended a good deal on how one went about it. More than 20 years ago, he did it at the Dover Gas-Works; but he had there an excellent Manager, who had formerly been a mechanic, and it very often happened that anyone might succeed or fail in anything according to the man who carried it out. This man simply put a 1½-inch hole in the top of his horizontal condenser, and into it he screwed a little valve, which was faced below. By the oscillation of the exhauster, this moved up and down, and let in a little air at each revolution of the exhauster. He at first found some difficulty in getting too much air, when down went the illuminating power of the gas; but, with a little practice, he got so thoroughly up to it that it worked for years, and required very little attention indeed. Still that was a mode he would not advise anyone to try who could not look very carefully after it. Another method had been to pass the gas through a meter, and into the purifier; but if the gas were pumped over and over again, as was sometimes done when the gas was obliged to be bye-passed, because there was not enough being made, and the exhauster was not going at the proper speed, a greater percentage of air might be put in than ought to be the case, because some of it was being pumped over and over again. Then there was another difficulty which must be guarded against; and Mr. Travers had a very excellent way of doing it. He put up a very small steam-engine and steam-pump; and this was worked in the presence, and under the control of, the man who worked the exhausters. He took the quantity of gas made every hour, and saw whether he was doing too much or too little. By having these statistics constantly before him, he was not likely to make a mistake. The President had referred to having done better with his purifiers when he used lime wetter than he had been in the habit of having it before; and he (Mr. Anderson) might say that when he first began to have anything to do with gas, he looked into the best authorities on the subject—Clegg's book for one; and there he found that the lime should be made so wet that if a handful was dug up and squeezed in the hand, it would retain its shape. He believed a great many people did that more or less even to the present day; but he formed the opinion that to purify gas there must be humidity, and the more humidity there was without doing damage the better. He, therefore, used his lime so wet that it would be almost all in little balls about the size of a walnut down to a pea—not in dust at all, but in small noddules; and although they were in the habit of putting the lime in 12 or 15 inches thick (the purifier being large enough), he never found the centre of the lime not as well worked off as the outside. The gas seemed to penetrate the whole mass; and by this plan they had double and even treble the quantity of gas purified that they would do if the lime were in the dry state which some books recommended. Mr. Humphrys had stated on the previous day that the sawdust put into his oxide after a number of revivifications was not so active as when it was first put in. He (Mr. Anderson) believed that Mr. Travers was doing a very good thing in using a small portion of lime with his oxide. By doing this, it was possible to get the oxide into the same condition as the lime was when wetted; and instead of the oxide going in in one homogeneous kind of mass, it might be put in in noddules as he had described the lime. If only so much lime were used as would cause a little adhesion, the oxide would give much less pressure than it now did.

Cooper's Coal Liming Company.—The Secretary of the Coal Distillation Company (Cooper's Patents), Limited, asks us to state that the offices of the Company have been removed to Nos. 322 and 323, Winchester House, Old Broad Street, E.C.

The Newcastle Water Company's Board.—The Directors of the Newcastle Water Company have elected Alderman Addison Potter, C.B., to fill the position of Chairman, previously occupied by Alderman Plummer, whose death was recently noticed in our columns. Mr. W. D. Cruddas has been appointed Vice-Chairman.

The Electric Lighting Industry.—The *Electrical Review* says: "Much activity is manifest just now in electric lighting circles. It is evident that a great desire exists to introduce the most formidable competitor of gas into a number of towns in the United Kingdom; and this will doubtless be satisfactorily accomplished within a short period. We do not anticipate, however, that gas shareholders need be alarmed; for we believe that the progress of electric lighting will lead to a still greater development of gas consumption in many ways."

Sulphuretted Hydrogen in London Gas.—In the report by Mr. W. J. Dibdin, F.I.C., F.C.S., on the quality of the gas supplied in the Metropolis during the week ending the 6th inst., there is the very unusual record of the presence of sulphuretted hydrogen in the gas tested at the Plumstead station (South Metropolitan Company) on the above-named day. In other respects the return was good. The illuminating power was in all cases above the standard; while the sulphur and ammonia were well below the quantities allowed.

Large Shipment of Steel Water-Pipes.—An unusual scene was witnessed a few days ago at the Hockley station of the Great Western Railway, when a large quantity of light steel water-pipes, made by Messrs. Piggott and Co., of Birmingham, were despatched to Glasgow for shipment to Mexico. Three special trains, each consisting of 42 waggons were sent away, and each pair of waggons carried 28 light steel spigot-and-socket water-pipes 12 and 14 inches in diameter by 24 feet long by 13 B.W.G. thick. The smaller pipes were stowed inside the larger to reduce freight; a saving being effected by this means, it is said, of about 50 per cent.

The Management of the Smyrna Gas-Works.—The Ascot District Gas Company are about to lose the services of their Manager, Mr. John Gandon (son of Mr. C. Gandon, of Sydenham), who has received the appointment of Assistant Manager of the Ottoman Gas Company, and will leave England for Smyrna in October next, to enter upon his duties. The reason of the appointment is, we understand, the retirement in March next of Mr. H. W. Andrews, the present Manager at Smyrna. Mr. Gandon will take up his new work well qualified by previous training for its efficient performance. He was his father's assistant at Sydenham for four years; was afterwards with Mr. Hack at Birmingham for about the same period; and has held his present appointment since 1882. He will leave England with the best wishes of his own and his father's many professional friends for his future prosperity.

North British Association of Gas Managers.—The programme of the 28th Annual General Meeting of this Association, which is to take place at Dunfermline on the 25th and 26th inst., has been issued by the Secretary (Mr. R. S. Carlow, of Arbroath). The meeting will be held in the St. Margaret's Lecture Hall, under the presidency of Mr. G. R. Hislop, of Paisley. After the transaction of the routine business, the President will deliver his Inaugural Address, which will be succeeded by the reading of papers. These are six in number, as follows:—"A Few Notes on Main Laying," by Mr. J. M'Crae, of Dundee; "A Retort-Setting for Small Gas-Works," by Mr. A. MacPherson, of Kirkcaldy; "Selling Gas," by Mr. Edwards, of Napier (N.Z.), to be read by Mr. J. M'Gilchrist, of Dumbarton; "Cessation of Work on Sundays," by Mr. T. D. Hall, of Montrose; "The Presence of Sulphur Compounds in Mineral Illuminating Oils," by Mr. A. Bell, of Peebles; and "Notes on Purifiers," by Mr. J. Hall, of St. Andrews. In the course of the proceedings the Sub-Committee on the Murdoch Memorial will submit their report. At the close of the business the members and visitors will dine together in the City Arms Hotel. On the following day there will be an excursion, in which, as usual, the members will be accompanied by lady friends, to the Clachan of Aberfoyle—Rob Roy's country—where lunch will be served in the Bailie Nicol Jarvie Hotel. With fine weather, this should be a very pleasant trip, and form an agreeable ending to what promises, from the programme of business, to be a most useful and instructive meeting.

Essays, Commentaries, and Reviews.

GAS AND WATER COMPANIES IN THE STOCK MARKET.

(For Stock and Share List, see p. 137.)

During the past week there was more activity in the stock markets; and the general tendency was decidedly better, especially after the first day or two. Money was abundant for investment; and choice securities were in demand. Gas and water not only maintained, but really improved the position they had attained the week before. Business has been brisk, especially in Home undertakings; and the advances in price are numerous and considerable. In Gaslights, the "A" opened at 262; and steadily improved; the best mark being 266¼. Transactions to an unusual extent have been effected in the other issues, especially the 7 per cent. maximum, which has risen 1½. In South Metropolitans, the rise in "B" which we noted as being imminent has come off, to the substantial figure of 4½. The debenture stock has made a further advance; and now commands a better price than it did last month with the half-year's interest in it. A single transaction was effected in each of the Commercial issues—two of them at "special prices;" but they all very firm. Among the Suburbans and Provincials, nothing has been touched but British, which changed a few times at good average figures; and all quotations remain undisturbed. Of the Foreign division, Imperial Continental has been moderately dealt in at an advance of 1½; San Paulo has effected the improvement of ½ which it promised; and Buenos Ayres has gone up ½—the rise being probably referable in some degree to the throwing out of the Belgrano Company's Bill. Bombay continues depressed; and ½ worse than the week before. The Water Department has been much quieter; some leading issues having been quite neglected. But there is no sign of suffering from lack of support; all changes of prices being, on the contrary, in the upward direction.

The daily operations were: Gas was only moderately active at the opening on Monday; but everything touched was very strong. Imperial Continental rose 1½. Water was similarly situated. Sellers of Southwork "D" were 2 higher. There was rather more doing in Gas on Tuesday, with increasing firmness. Gaslight "A" rose 1½; South Metropolitan "B," 2; and the debentures, 2. Bombay fell ½. Water was more active, and still on the rise. East London debenture advanced 1½; Southwark ordinary, 1½; and ditto "D," 1. Gas continued fairly active on Wednesday, especially Gaslight issues of all descriptions. South Metropolitan "B" gained 2½ more. Water was quiet, at high prices. Southwark ordinary was 1 higher. On Thursday, Gas business was about the same as the day before. Everything was very firm; and San Paulo rose ½. Transactions in Water were moderate, at good figures. Business on Friday was largely in Gaslight issues, which were strong; but quotations did not move up. In Water, the only Company dealt in was Grand Junction; the price advancing 1½. There was not very much doing on Saturday in Gas; but there was no diminution of strength. Gaslight "H" improved 1½; and Buenos Ayres, ½. Water was hardly noticed; and all quotations remained unchanged.

ELECTRIC LIGHTING MEMORANDA.

ELECTRIC LIGHTING ORDERS—A CRITICISM OF THE TRANSACTIONS OF THE LEEDS ELECTRIC LIGHTING COMMITTEE—FIRES CAUSED BY ELECTRIC LIGHT WIRES AT THE PARIS EXHIBITION—THE CHARLTON FATALITY—FAILURE OF AN ELECTRICAL ROAD CAB.

There has not been anything like a "rush" on the part of speculators in electric lighting to make application for Provisional Orders under the Electric Lighting Act for the current year; the last day for receiving notices being Monday of last week. It is probable that the people likely to be interested in such ventures are awaiting the first result of the gigantic experiments to be tried in London, by supporters of the alternating-current and direct-supply systems respectively, before putting any more money into this business. The Companies in question are pushing on with their Orders, as will be seen from our Parliamentary Intelligence, and some objection has been taken in the House of Commons to the fact of the Confirmation Bills having been put down for second reading before the explanatory memorandum of the Board of Trade was in the hands of members. There yet remains a good deal of work to be done upon these Orders before they receive the sanction of Parliament; The Gaslight and Coke Company, among other opponents, having lodged petitions against all of them. It remains to be seen what are the points particularly relied upon by the Gas Company; but it is quite possible that they may be tired of playing the part of a stop-gap to make good deficiencies in the electric light supply. There was a provision inserted in the Electric Lighting Act for relieving Gas Companies of their liability to supply in districts where by reason of the introduction of the electric light their business had been rendered unprofitable; but we are a long way yet from witnessing any action under such enactment. It may be that the Gas Company have taken note of the American precedent recently quoted in the Journal, when a Gas Company was absolved from liability to supply a larger meter than they found necessary to pass the small quantity of gas required by a consumer while the greater part of his lighting was supplied by an Electric Light Company. Or the Gas Company may be only solicitous about their mains and other property. Perhaps the Chairman, Col. Makins, M.P., will have something to say about the policy of the Company in this regard at the approaching general meeting.

The report of the Electric Lighting Committee of the Leeds Town Council, stating what has been done with the money voted by the Corporation in May, 1883, for the purpose of lighting the Municipal Buildings, and recommending an extension of the experiment at an additional immediate cost of £25,000, with the prospect of increasing the capital expenditure to £68,000, is rather severely handled by the *Electrical Review*. Our contemporary of course does not find fault with the idea of spending money upon electric lighting, but only allows it to be understood that it does not think the Committee have done the best possible with their means and opportunity in the past. "All that the Committee have to show is the lighting of the public library by incandescent lights, and the arc lighting of the Victoria Hall; the former of which was not completed until some expenditure was occasioned by threatened litigation. The remainder of the above larger sum has been disbursed in the numerous expeditions of the various members of the Committee to innumerable places in the United Kingdom during the past six years, to investigate the various possible and impossible systems of electric lighting. The result of their first inspections and report ended fairly well in a *fiasco;* but we have now the final conclusions at which the Committee have arrived, and the recommendations which they place before the Council—it is but right to point out that this report is not submitted until *all* the money voted has been spent." After this it seems strange that our contemporary can recommend the Corporation to entrust the same Committee with a greatly increased capital to waste in the same way. It would be more logical to conclude that a Corporation Committee is as wasteful and inefficient in carrying on an electric lighting experiment as experience shows the same agency to be in the control of a gas undertaking.

It is reported that three fires have broken out in the Paris Exhibition through bad insulation of the electric light wires. Two were insignificant, but the third threatened serious consequences, and was only subdued after half-an-hour's hard work on the part of the fire service of the establishment. Bad work by the electric light fitters is assigned as the original cause of this trouble; but the fact is a significant comment upon the supposed safety of this system of lighting. Users of the light are blamed for employing contractors to do their wiring without any efficient control; but the truth of the matter probably is that everything about the electric light in the Exhibition is so exorbitantly dear, that stallholders who only require the lamps for advertising purposes are apt to try to get the wiring and fixing done as cheaply as possible. They do not know good work from bad; but they know a big estimate when they see it, and are thereby driven into the hands of irresponsible persons who are scarcely competent to fit up bells, to say nothing of arc lamps.

The fact that a man was recently killed at the works of Messrs. Siemens Bros., at Charlton, revives the uneasiness that was at one time so generally felt regarding the possibility of such accidents in places where electric lighting gear of any kind is exposed to the touch of meddlesome individuals. In the present case the victim was killed through handling an instrument which he had been expressly warned not to touch; but notwithstanding that the man paid the penalty of what was really his own disobedience to orders, it may be easily understood that the catastrophe has created a painful impression upon the designer and makers of the apparatus. Of course, men will continue to be killed through rashly and ignorantly meddling with machinery of all kinds; but the circumstance that there is no warning or indication of its deadly powers given by an innocent-looking wire or stud in an electrical circuit is a disturbing reflection. A weary workman may rouse himself in time to get out of the path of a locomotive, and any man will be active in slipping from under a toppling weight; but there is nothing to warn him of the sudden death lurking in the charged wire that looks so harmless. Hence the ingenuity of electrical engineers should be exercised to protect the thoughtless and the ignorant against themselves.

Electrical traction on common roads has its future still before it. A rather amusing instance in point was supplied at the recent Military Tournament at the Agricultural Hall, London. The organizers of these annual displays are always anxious to freshen up their programme with novelties; and this year it was announced with a particular flourish that an armour-plated waggon propelled by electricity would be used in the mimic battle with which the displays terminate. The glorious uncertainty of electricity was again manifested in connection with this wonderful vehicle, however, for after the first day, when it refused to quit the field of action at the proper time and had to be ignominiously dragged off by its own crew (strongly reinforced, for this occasion only, by the enemy), it rested out of danger and also outside the scene of operations. Great efforts were made to get it ready to be shown at least once more, on the concluding day of the meeting; but we have no information as to whether these were successful or not. Considerable expense must have been incurred in the fitting up of the waggon; and its failure must naturally have been a bitter disappointment to its makers.

At the last meeting of the Society of Arts, Mr. F. G. Dexter, Gas Engineer of the Wantage Improvement Commissioners, was elected a member.

At the meeting of the London County Council last Tuesday, Mr. J. Gordon, Borough Engineer and Surveyor of Leicester, was appointed Chief Engineer of the Council, at a salary of £1500 per annum.

MR. M. S. GREENOUGH ON FUEL GAS.

It is by no means an easy task to gather clear and precise information respecting technical work in the United States; and this is greatly to be regretted, because the valuable experience that must be gained in such a large and bustling community is not made available for the general instruction. There are plenty of technical periodical publications published in the country, the editors and contributors of which usually appear supremely well satisfied with themselves; but the conductors of American journals on the whole do not possess the secret of conveying information in the only shape that is really useful to practical men. Movements in the industrial systems of the country arise and swell into importance, and it is only by diligent perusal of a mass of generally irrelevant printed matter, and the deduction therefrom of hazardous inferences, that a stranger can form any idea of what is going on. It is perhaps because there are too many journals requiring the support of the physical science and mechanical arts of the States that they are individually so poor and non-representative. One of these periodicals not long ago published an envious notice of the enterprise of our contemporary *Engineering* in giving that remarkable French Exhibition number which may justly be regarded as one of the triumphs of modern technical journalism; and regretfully confessed that nothing similar is possible for the scattered American engineering journalism among which the strength of the native *technique* is frittered away. There is not sufficient concentration of support for any particular organ of any branch of industry, to make it worth while for skilled men interested in that branch who may happen to possess the gift of literary expression, to devote themselves to its journalism. Consequently it is observable that the majority of the ostensibly technical journals of the States are in the hands of men without any claim to be respected as authorities upon, or even as passably acquainted with, the industry of which they pretend to be exponents. They have received a general training in some newspaper office, and wield the scissors with industry if not with conspicuous discrimination. Unfortunately, they are invariably infected with that longing after the funny at all costs, and propensity to retail the smallest of small talk, which is so irritating to a reader in search of facts, especially when the subject matter is of a professional or business character. As for representing soberly and accurately the drift of contemporary opinion and effort, the average American journalist can no more do anything of the kind than he could rival Shakespeare or Homer. If he calls himself a mechanical engineer (journalistically), he will make up the bulk of his paper with clippings more or less relating to mechanical engineering from all sources; but he dearly loves to break off into a would-be comic story about an engine driver. If he poses as a gas journalist, it is only the slangy babble of a gas managers' banquet that he really comprehends.

As already stated, this weakness is regrettable for the amount of truly noteworthy information that is left out of the chronicle of the day by those who ought to take account of it, but are incapable of distinguishing wheat from chaff. They give us plenty of the latter; but grains of the former are few and far between. If it were not for the occasional utterance of some well-known engineer, in the form of address, paper, or letter, it would be thought that mechanical art and industry are at a low level in the States. In matters of gas supply it is rarely anything noticeable transpires outside the District Associations; and these are naturally more concerned with local affairs and points of detail than with general movements. They mirror the latter in their constitution, but do not deal with their causes. For example, when a District Gas Managers' Association of the States that was once wholly composed of coal gas men becomes largely alloyed with water gas men, to say nothing of electricians, we may infer that something has been going on under the surface to render the change inevitable; but where shall a reader learn about this? As a matter of fact, we gather most of the information concerning American gas affairs which we impart in the columns of the JOURNAL, from statements and communications of friends on the other side. It is extremely rare that anything of the kind is first made public in the States; and therefore it is with the greater pleasure that we note a recent letter from Mr. M. S. Greenough, of the Boston Gaslight Company, apparently sent by his correspondent to the *American Gaslight Journal*, which deals with the at present burning question of fuel gas. It must be understood that the possibility of creating a profitable business in the distribution of fuel gas is actually being discussed in the States. The question must be distinguished from that of water gas, although it appears to be a development or modification of the latter system, consisting in the proposed sale of water or generator gas for use as fuel without being carburetted as it is at present when sold as a means of lighting. The idea originated in the natural gas regions, where it came to be asked whether, if the natural supply should give out, anything of the same character could be artificially made at a fair price. The answer is understood to be in the affirmative, under certain conditions, and accordingly some gas companies lying away from the "natural gas belt" are considering whether they cannot go into this branch of business at once. A representative of the Waltham Gas Company put the question to Mr. M. S. Greenough, and his answer, published in the manner already stated, gives some highly interesting information respecting the general subject which would be looked for in vain elsewhere.

To begin with, Mr. Greenough tells his correspondent that while an experiment in the supply of fuel gas at Waltham would be interesting and valuable to gas engineers, he cannot recommend it from any example of a similar enterprise carried on profitably in another town. At the same time he describes the circumstances under which an experiment of the kind is actually being tried at Jackson, Michigan, a city of about 25,000 inhabitants. This place is provided with coal gas-works, Edison incandescent lights, 223 arc lamps, and a fuel gas-works, affording a means of lighting by the use of the Fahnejelm incandescent burner. There is thus plenty of competition; and Mr. Greenough thinks the lighting of all kinds is provided at prices which do not allow much margin for profit. The arc lamps are rented at $88, or less than £18 per annum; the incandescent Edison lamps may be had for as little as 30 cents, or 1s. 3d. per month; coal gas is from $1.75 to $1.35 (7s. to 5s. 6d.) per 1000 cubic feet; and fuel gas is 50 cents., or 2s. per 1000 cubic feet, with discounts bringing down the price to 30 cents., or 1s. 3d. per 1000 cubic feet if the monthly consumption averages 5000 cubic feet. At these rates the fuel gas company claim to be making a living, selling 180,000 cubic feet of gas per day on the average. If they could double their output, as they profess to be confident of doing, they declare they could make a handsome profit. Their maximum sale last winter was 300,000 cubic feet, to nearly 500 consumers. A large proportion of the gas is used for lighting; and it is reported that 4000 Fahnejelm combs are employed for this purpose. These are very friable, and are worn away by the heat, requiring to be changed about once a week if in much use. "As to the character of the light, there is considerable difference of opinion. It is almost perfectly white, with a slight bluish colour, and looks dim when compared with the bright yellow tint given by gas or the Edison light. There is no doubt, however, that a room can be lit more cheaply in this way than by any other means; but that it would be generally popular among people who could afford any light but the cheapest I cannot think." Notwithstanding some local evidence to the contrary, Mr. Greenough maintains that the light is not at all an agreeable one.

With regard to the manufacture of the fuel gas, Mr. Greenough says it is made from soft (bituminous) coal, which is put into ordinary retorts; and about three-fourths of its gas distilled off, as in the common process of gas manufacture, the remainder being allowed to go to waste. The coke is then drawn directly into a a generator situated immediately in front of the retort bench, with its top at the floor level, where it is made into water gas by alternately blowing up into active incandescence and then admitting steam to be decomposed. The fuel used under the retorts is crude petroleum, which is more than paid for by the tar obtained from the distillation process, so that all the coke is left to be made into water gas. The resultant mixed product would be about 36,000 cubic feet of gas per "short ton" (2000 lbs.) of coal, of which five-sixths would be water gas and one-sixth coal gas. If the fuel in the generator is not permitted to become too thin, the mixture—principally hydrogen, carburetted hydrogen, and carbonic oxide—would have a calorific power of 400 heat units per cubic foot. These figures may be studied in connection with recent statements relating to the subject from Mr. J. F. Bell and others. It is an interesting point in Mr. Greenough's communication that if the bed of fuel in the generator becomes too low, a proportion of carbonic acid gas is formed which depreciates the heating value of the mixture; while if more than one-sixth part of coal gas is found in it, there is a deposit formed on the incandescent comb which seriously interferes with its lighting efficiency.

On the whole, Mr. Greenough thinks that this process might be improved upon in the direction of saving the producer gas made during the "blowing-up" stage of water gas manufacture, which could be used at Waltham instead of the coal consumed under the boilers of the Company's electric lighting plant. At the same time, so long as any new process has not arrived at the point of earning dividends, Mr. Greenough regards it as a mere experiment which he would not be justified in recommending as a permanent business. Consequently he will not take the responsibility of advising the Waltham Company to go into it; although admitting that his view is perhaps ultra-conservative and not presuming to assert its superior wisdom when compared with contradictory advice. This is as much as to imply that he would like to see the experiment tried, but will not positively recommend it.

Apart altogether from this aspect of the case, the British gas manager deprived of all prospect of initiating any new departure from settled routine may be disposed to envy his freer American brother, who can go in for electricity, fuel gas, or anything else that offers a chance of paying. These are the circumstances that enable a man to show what he is made of; and although we do not see how fuel gas is to be distributed at a profit in England except under very peculiar circumstances, we wish sometimes that our energetic gas managers could find some such opening for their enterprise and skill.

PROJECTED INTERNATIONAL FOOD AND COOKERY EXHIBITION.—A project is on foot for holding an international food and cookery exhibition in the Agricultural Hall, Islington, from the 4th to the 16th of November next. The arrangements are in the hands of Mr. Harry Etherington, who has been identified with so many successful displays in the same building; and there is every probability that they will be satisfactorily carried out. Sections will be devoted to cooking apparatus and illuminants; the former embracing gas and other stoves, and the latter comprising gas and electric lamps and fittings. Conferences will be held and lectures delivered during the exhibition.

Communicated Articles.

THE CHEMISTRY OF ILLUMINATING GAS.

By Norton H. Humphrys, Assoc. M. Inst. C.E., F.C.S.

XXIII.

Mr. T. G. Barlow tried a series of experiments on White's process with an apparatus erected for lighting a silk mill near Manchester.* They comprised 24 hours' manufacture of unpurified water gas made from charcoal; the same with gas made from ordinary Newcastle coke; 24 hours' manufacture of lime-purified hydrocarbon gas from Boghead cannel and charcoal; 24 hours' manufacture of lime-purified hydrocarbon gas from Newcastle coal and its own coke; and the same purified by oxide of iron instead of lime. In the course of 5¾ hours, the retorts being at a high temperature, the quantity of gas produced from charcoal and steam was 3426 cubic feet, having a composition of 16½ per cent. carbonic acid, 25·75 per cent. carbonic oxide, and 58·75 per cent. hydrogen. At this time the temperature of the furnace had fallen so much that 1½ hours rest was allowed; but after resuming operations, the rate of production was not much more than one-half, which is ascribed to the inferior quality of the coal used as fuel, and to the fact that the charcoal in the retorts was only rammed up once, instead of at frequent intervals. The proportion of carbonic acid increased so that the total day's production was 9332 cubic feet of gas having a composition of 2 parts carbonic acid, 20 carbonic oxide, and 60 hydrogen. If the carbonic acid was removed by purification, the yield of gas would be 7466 cubic feet. The second day's experiment consisted of the use of Newcastle gas coke instead of charcoal; and it was found to be far inferior. The yield of gas was only 4951 cubic feet, or at the rate of 281 cubic feet per hour, though the composition was about the same. The same difficulty was experienced in keeping up the heats; and it was also necessary to stop to "ram up" the coke. If we accept the abnormally good results obtained at the commencement on the first day, the results obtained with the coke are about 20 per cent. below those with the charcoal.

On the third day, the manufacture of hydrocarbon gas was commenced. The coal-retort was charged with ¼ cwt. of Boghead cannel at intervals ranging from 1½ to 2 hours; and charcoal was used in the water-gas retorts. After the first charge, 1½ hours rest was necessary to get up the heats, so this was left out of consideration. The eight charges, Nos. 2 to 9, representing 4 cwt. of cannel, produced 5304 cubic feet of gas. The gas contained 14 per cent. condensable hydrocarbons, and also 7 per cent. of carbonic acid, which had escaped purification by lime; so the crude gas must have contained a great deal more. The photometrical value of the gas consumed in a large-size fishtail burner at the rate of 5 cubic feet per hour, was 17·3 candles; and it therefore represented 1753 lbs. of sperm per ton of cannel used. Mr. Barlow's estimate of the value of Boghead cannel distilled in the ordinary way was only 2057 lbs. of sperm—much less than that ascribed to it by Dr. Fyfe; but at this figure the hydrocarbon process shows a loss of 24 per cent. of illuminating matter, the cause of which was next investigated. The 5304 cubic feet of gas represented 2560 cubic feet of cannel gas, 2373 of carbonic oxide and hydrogen, and 371 of carbonic acid. The removal of 6½ out of the 7 per cent. of carbonic acid more than doubled the illuminating value; and Mr. Barlow estimates that with due attention to this point, the gain of illuminating value due to the hydrocarbon process would be upwards of 50 per cent.

On the fourth day, Newcastle cannel and charcoal were used: and a rest of 7½ hours was allowed for getting up the heats, the results of which are shown by a large increase in the proportion of water gas yielded. Seven charges of coal, representing 6 cwt. 2 qrs. 14 lbs. were used in the course of rather less than 20 hours, and the yield was 9666 cubic feet, representing 2814 feet of coal gas and 6842 feet of water gas. This contained 4·25 per cent. of condensable hydrocarbon, and 11 per cent of carbonic acid; though it had been passed through the lime purifiers. It was valueless as an illuminant, being of less than 2-candle power. The effect of removing 10 out of the 11 per cent. of carbonic acid was to increase the illuminating value to 12½ candles when consumed in the fish-tail burner. And Mr. Barlow estimates that if the whole of the carbonic acid were removed, the gain in illuminating value would be 40 per cent. as compared with direct distillation.

The fifth day's experiments were similar to the fourth, except that coke was used in the charcoal retorts, and that oxide of iron was used instead of lime in the purifiers. The yield of gas was less, being 23,384 instead of 29,180 cubic feet per ton; and its quality a trifle better, being 2¼ candles, although it contained about 12¼ per cent. of carbonic acid. In the course of this experiment a 4-hours' stoppage took place, and the result was an improvement of 15 per cent. in the rate of yield of gas. On removing the carbonic acid, the illuminating power was increased to 13¼ candles, and the gain in illuminating value per ton of coal was 10 per cent. Mr. Barlow infers from this experiment that the whole of the carbonic acid formed in the water-gas retorts passed unaltered through the cannel retort.

The consumption of fuel during the five days was 35¼ cwt. of common furnace coal, and 3 cwt. of coke; but is remarked that the construction of the furnace was very defective. The consumption of charcoal and coke in the water-gas retorts was at the rate of 26½ lbs. per 1000 cubic feet of purified water gas, whereas the theoretical requirement to produce equal parts of hydrogen and carbonic oxide would be only 16 lbs. From these results Mr. Barlow believed that the hydrocarbon theory was sound, but difficult of application in practice. It was difficult to maintain the water-gas retorts at a temperature sufficiently elevated to ensure the uniform decomposition of the steam; and therefore the rate of production was irregular, varying from 160 to 870 cubic feet per hour. The large quantity of carbonic acid, in proportion to the combustible gases, was an objection; and it was difficult to maintain the proper proportion between the cannel and the water gas. He therefore recommended that the water gas should be collected in an intermediate holder, and supplied to the coal gas in regulated quantity, preferably in proportion to the production of coal gas. He did not think it possible with iron retorts to produce a gas containing less than 16 to 20 per cent. of carbonic acid; and recommended the use of additional carbonizing surface, as would be obtained by passing the gas through a retort filled with incandescent coke, in order to convert the bulk of the carbonic acid into carbonic oxide. At London prices, the cost of the hydrocarbon process would be about the same as that of direct distillation with Newcastle coals, but cheaper with cannels. This estimate is incorrect insomuch as the cost of purification is taken at less in the case of the hydrocarbon gas. The 10 or 12 per cent. of carbonic acid could not be removed at a less cost than 4d. or 5d. for lime, and this would more than counterbalance any advantage due to the process. The cost of the charcoal or coke consumed in the water gas retorts appears to be under-estimated. With these corrections, the cost of the hydrocarbon process is in excess of direct distillation in every case.

The chief feature in the foregoing scheme is the attempt to produce water gas with apparatus evidently modelled on that used for coal gas. The feasibility of improving on this was not overlooked, as may be seen from a very elaborate report on the manufacture of illuminating gas by direct distillation, as compared with a process proposed by M. Galy Cazalat which was presented to the Association of Artists and Inventors in France by a Committee of whom M. Faure was chairman.* The new process embraced many of the principal features of modern water-gas apparatus. In place of furnaces and retorts, one large vessel similar to a smelting furnace was provided. It was in the first place charged with coke, which was ignited and raised to incandescence throughout. A charge of coal was then introduced on the top of the coke, and all openings closed up with the exception of a suitably arranged outlet for gas, leading to an ordinary gas purifying plant and holders. This outlet was at the base of the vessel, so that the generated gas had to travel through the hot coke before escaping. The charge of coal being so proportioned as to admit of the heat accumulated in the furnace doing the work of carbonization, after a time it would be completely carbonized, and the furnace would contain a mass of incandescent coke. This could be used for the production of water gas by admitting steam through jets provided for that purpose, which could be conducted to a separate purifying and storeage plant, and supplied as a heating gas or could be carbonized and mixed with the coal gas as desired. The whole subject is investigated from a theoretical point of view; and it does not appear that the apparatus had actually been constructed and put into practical use. But it comprises the chief points of most of the modern water and fuel gas apparatus.

About this period, attention was being directed to Gillard's, light, which included a forestallment of the modern platinum incandescent gas-burner. According to an article in the Journal † retorts containing carbon were raised to a white heat, and steam was passed in contact with it; the idea being not to secure a mixture of hydrogen and carbonic oxide with as little carbonic acid as possible, but to purposely form a quantity of carbonic acid, which could be removed in lime purifiers, leaving a gas consisting chiefly of pure hydrogen. A cap or thimble of platinum gauze was adapted to an ordinary Argand burner; and the gas, which was perfectly non-luminous, but possessed great heating capability when burnt in this arrangement, raised the platinum gauze to a high temperature, producing a steady bright light. There is no question as to the efficiency of the device; but that of cost came in, and caused the commercial failure of the project. The light afforded is clear and steady, and the gas is pure and free from soot or sulphur. But a large quantity of heat and moisture is produced, so that efficient ventillation in connection with this system is a necessity, the more so on account of the large quantity of oxygen consumed. According to the report of an eye-witness, quoted in the article now under review, the light afforded by a consumption of 5·2 cubic feet per hour was greatly inferior to that from an ordinary gas-burner. Mr. Hodgetts, of Manchester, tried the system in a drawing-room 30 ft. by 12 ft., having a 3-feet gaselier and two side-lights, each burning 6·5 cubic feet per hour. The effect was by no means brilliant; and he subsequently tested one of the burners at the photometer, and concluded that it was about equal to 5½ composite candles of 6 to the pound. According to some figures obtained at an experimental works in France, it appears that the gas consisted of 77 parts hydrogen, 15 carbonic acid, and the remainder was water, air, and carbonic acid. The materials used were about 17 lbs. of charcoal, 44 lbs. of coal as fuel, and more than 1 cwt. of quick lime for purification, per 1000 cubic feet of gas made. The cost, including labour and depreciation, would be about 4s. per 1000 cubic feet, and this for a gas far inferior in light-producing power (as shown by the above experiments) to ordinary coal gas.

* See Journal, Vol. III., pp. 450, 475.

* See Journal, Vol. V., p. 9, *et seq.* † *Ibid.*, Vol. V., p. 119.

A difficulty also arose in connection with this method of producing light, that has not yet been remedied; and that is the pressure. To produce the best results, a pressure of about 30-10ths was found to be necessary, and the writer has not seen any modern incandescent burner that would work with much less. Some are passable at 20-10ths, but do not develop their best results. Until this can be remedied there will always be a great practical objection to the use of incandescent burners. Even within the last few months much disappointment has been experienced by country customers who have been led to purchase this form of burner, by seeing it in satisfactory operation in some of the main thoroughfares of London. When the burners are taken to country towns, where the pressure at the consumers' burners is usually under 15-10ths, they fail to yield a proper light, and the gas is blamed for this result.

REFORM IN PYROLOGICAL TERMS AND CALCULATIONS.

By C. J. Hanssen, C.E., of Copenhagen.

The most appropriate and very interesting article on "Pyrology" which appeared in the Journal on the 4th ult. (p. 1038) induces me to publish certain proposals which I worked out some time ago, and which I think would serve to make pyrological investigations and calculations more easy and trustworthy, as well as more universally applicable and comparable, than hitherto. In studying technical records and publications, we find that hardly two authors give the specific gravity and specific heat, especially of aëriform substances, perfectly alike. Some reduce their weights to the 45th degree of latitude and sea-level; others to the latitude and elevation of London, Paris, Berlin, &c. Some writers prefer the English standard weights and measures and the Fahrenheit thermometer; others the metric weights and measures and the centigrade thermometer; while some even use both systems in one evening's lecture. In short, a great and serious confusion prevails in these matters; and last, but not least, some of the great masters in the science of heat find wide variations between the experimental and the calculated values of coal and other fuels.

Pyrological Units and Terms.—I would propose to adopt for England 100 gallons as the unit of volume, and to call this unit a *centgallon*. This volume of water would be equal in weight to 1000 lbs. Then 0·1 gallon, called a *decigallon*, would be equal to 1 lb. of water; and thus form a similar proportion as the cubic metre, litre, and kilogramme. *All calculations based upon one of these standards will be identical, if only the Centigrade thermometer is used in every case.* As 100 gallons equal (very nearly) 16 cubic feet, it is also easy to reduce the centgallon to the gas-works standard of 1000 cubic feet.

As the universal *volume-unit* (V.U.), either the centgallon or the cubic metre may then be used; as the universal *gravity-unit* (G.U.), either the English pound or the French kilogramme; and as the universal *caloric-unit* (C.U.), either the quantity of heat required to raise the temperature of 1 lb. or of 1 kilo. of water 1° C.

Unit of Work.

1 U.W., 1 lb. raised 1 foot high = 0·138249 m. kg. = $\frac{4}{29}$ m. kg.

1 U.W., 1 kg. „ 1 m. „ = 7·233 foot-pounds = $\frac{75}{10}$ lbs.

If these symbols are used only as general expressions, they may be written as above; but if they are to indicate especially English or metric standards, I should propose to write:

1 V.U. = 1 centgallon = 100 gallons = 16 cubic feet.

1-1000th V.U. = 1-1000th centgallon = 0·1 gallon (decigallon) = 1 lb. of water.

1 G.U. = 1 lb. of water = 1 decigallon.

1 C.U. = 1 lb. of water heated 1° C.

V.U. = 1 cubic metre.

G.U. = 1 kilogramme.

C.U. = 1 kilogramme of water heated 1° C.

Specific Gravities and Specific Heats of Gaseous Substances.—As atmospheric air is not a simple substance, but a mixture of at least three different gases whose proportions are constantly varying, neither its specific gravity nor its specific heat is constant, and it is therefore not a suitable unit for expressing the specific gravities and specific heats of other substances. Moreover, its relation to other gases and to water can only be approximately expressed by a long row of decimals, which are tedious to manipulate. The proper unit for the specific gravity of gaseous substances no doubt is hydrogen; but it is extremely difficult to find the specific gravity of hydrogen accurately by experiment. It is therefore advisable to calculate it from the specific gravity of oxygen gas, which has been ascertained with great accuracy by Regnault. But even a suitable unit would be useless if its value were not adopted universally. The weight of 1 cubic metre of oxygen at 0° C. and atmospheric density 1760 mm. of mercury, as determined by Regnault, is:

At 45° lat. and sea-level	1·42909 kilos.
In London, 51° 30′ 49″ lat. and 50 metres above the sea	1·42991 „
„ Paris, 48° 50′ 11·2″ „ 60 „ „	1·42913 „
„ Berlin, 52° 30′ 16·7″ „ 40 „ „	1·43003 „

Somewhere near 45° lat. and 50 to 60 metres above sea-level there must be places where the weight of one cubic metre of oxygen at 0° C. and atmospheric density is = 1·42857 kilogramme, or exactly 1-700th of 1000 kilos. or of 1 cubic metre of water. At such a place an international observatory and laboratory should be established, for the exact determination of specific gravities; and this weight should be adopted as the universal basis and unity in all calculations for gaseous substances. If this standard is adopted, then it follows that, at 0° C. and atmospheric density—

1 c. metre of oxygen weighs $\frac{1}{700}$ kilos., and 1 kilo. of oxygen = $\frac{1}{700}$ c. metre

1 centgallon „ „ $\frac{1}{700}$ lbs., „ 1 lb. „ „ = $\frac{1}{700}$ centgallon

Or, expressed in general terms—

1 volume-unit (V.U.) of oxygen = $\frac{1}{700}$ gravity-units (G.U.), and 1 G.U. of oxygen = $\frac{1}{700}$ V.U.

Then by the laws of atomical combination may be found the weights and volumes of all other gaseous substances, viz.:—

1 Volume-Unit =	Gravity-Units.	1 Gravity-Unit =	Volume-Units.
Water (liquid)	1000	Water (liquid)	1-1000th
Hydrogen	$\frac{100}{7} = \frac{50}{3}$	Hydrogen	$\frac{7}{100} = \frac{3}{50}$
Carbon (aëriform)	$\frac{88}{3} = 14\frac{2}{3}$	Carbon	$\frac{3}{88} = \frac{1}{14\frac{2}{3}}$
Nitrogen *	$\frac{350}{9}$	Nitrogen	$\frac{9}{350}$
Atmospheric air †	$\frac{135}{4}$	Atmospheric air	$\frac{4}{135}$
Carbonic oxide	$\frac{2}{1}$	Carbonic oxide	$\frac{1}{2}$
Carbonic acid	$\frac{275}{4}$	Carbonic acid	$\frac{4}{275}$
Marsh gas	$\frac{8}{1}$	Marsh gas	$\frac{1}{8}$
Ethylene (C_2H_4)	$\frac{7}{1}$	Ethylene	$\frac{1}{7}$
Ammonia	0·7615	Ammonia	1·318
Vapour of water	$\frac{14}{25}$	Vapour of water	$\frac{25}{14}$

As all the figures found, except those for nitrogen and nitrogen compounds, can be expressed accurately by common fractions, but only approximately by long rows of decimals, I have found it most convenient to use fractions. These weights per volume-unit I propose to call *Relative Weights of Gases*, and the volumes per gravity-unit *Relative Volumes*.

Heat required to raise the Temperature of Gases 1° C. per Volume-Unit (V.U.) *and per Gravity-Unit* (G.U.).—According to the law that at equal temperatures and density, equal volumes of gases contain an equal number of atoms, and that equal numbers of atoms require equal quantity of heat to raise their temperature 1° C., it follows that the volume-units of the simple gases, hydrogen, oxygen, nitrogen, and carbon, and of the mixed gases, carbonic oxide and air, which in mixing have retained their original volume, contain at 0° C. and atmospheric density an equal number of atoms, and therefore can be heated 1° C. by equal quantities of heat. But the weight of the atoms varies as the relative weights of the gases. It follows, therefore, that the heat required to raise the temperature of one gravity-unit (G.U., pound, or kilogramme) must vary *directly* as its relative volume, and inversely as its relative weight. Gases consisting of two or more simple gases, which, in combining, have contracted into smaller volume—such as carbonic acid, marsh gas, ethylene, vapour of water, &c.—contain in one volume-unit (V.U., centgallon, or cubic metre) all the atoms contained in the gases of which they consist; and one volume-unit of a composite gas requires, for raising its temperature 1° C, all the heat due to the combined volume of gases of which it is formed. This quantity of heat multiplied by the number of volume-units contained in one gravity-unit is the heat required to raise the temperature of one gravity-unit (G.U., pound, or kilogramme) of the gas 1° C. In the metric system the calorie is the quantity of heat required to raise the temperature of 1 kilogramme of water 1° C.; but, as stated above, I term it caloric-unit (C.U.), and apply it for 1 kilogramme or for 1 lb. of water heated 1° C.

The following table gives the results of my calculations based on the laws stated above, and worked out and revised with extreme care. All the figures can be used either for centgallons and pounds, or cubic metres and kilogrammes, without in any way altering their value and meaning:—

Heat required to raise the Temperature of Gases of 0° C. and Atmospheric Density 1° C.

Substances.	Relative Heat required. Per 1 V.U.	Per 1 G.U.	Specific Heat of Water = 1. At Constant Pressures.	At Constant Volume.
Hydrogen	1	100	$\frac{1}{7}$ C.U. × 0·706 = $\frac{1}{9\frac{9}{10}}$ C.U.	
Oxygen	1	6¼	$\frac{1}{15}$ „ „	$\frac{1}{21}$ „
Nitrogen	1	7$\frac{9}{25}$	$\frac{1}{19}$ „ „	$\frac{1}{24}$ „
Carbon	1	8$\frac{1}{3}$	$\frac{1}{17}$ „ „	$\frac{1}{3}$ „
Carbonic oxide	1	7$\frac{1}{7}$	$\frac{1}{17}$ „ „	$\frac{1}{25}$ „
Carbonic acid	1	6$\frac{9}{11}$	$\frac{1}{11\frac{1}{10}}$ „ „	$\frac{1}{25}$ „
Marsh gas	2	31¼	$\frac{1}{15}$ „ „	$\frac{1}{4}$ „
Ethylene	3	21$\frac{7}{9}$	$\frac{1}{9\frac{1}{2}}$ „ „	$\frac{1}{15}$ „
Ammonia	2	23$\frac{7}{10}$	$\frac{1}{10}$ „ „	$\frac{1}{12}$ „
Vapour of water	1½	16$\frac{2}{3}$	$\frac{1}{17}$ „ „	$\frac{1}{2}$ „
Air	1	6·912	$\frac{1}{9\frac{97}{100}}$ „ „	$\frac{1}{1}$ „
Water (liquid)	—	29·412	1 „ „	— „

Expansion of Gases by Heat.—As gases expand in direct proportion to their absolute temperature, and the 0° of the Centigrade thermometer is equal to 273° C. absolute, it follows that one volume-unit of any gas heated from 0° C. (273° absolute) to 273° C. (546° absolute) or to 546° C. (819° absolute) will expand to two, three, &c., times its original volume; but the number of atoms in each volume-unit of the heated gas will decrease in direct proportion as the absolute temperate and volume

* Some authors assume nitrogen to have specific and atomic weight equal to 14 times that of hydrogen; but if this were the case, either the well-ascertained proportion between oxygen and nitrogen in the atmosphere or the specific weight of air must be wrong. It is no doubt a wise and merciful provision in Nature that the atoms of nitrogen do not fit properly to those of oxygen; otherwise these two chief constituents of our atmosphere would have combined long ago, and the combination would have annihilated all life on the globe.

† Atmospheric air contains in 10,000 V.U.:—

2097 V.U. oxygen @ $\frac{1}{7}$ G.U. = 2995$\frac{5}{7}$ G.U.

7900 „ nitrogen @ $\frac{9}{25}$ G.U. = 9914$\frac{1}{2}$ „

3 „ carb. acid @ $\frac{8}{11}$ „ = 5$\frac{1}{11}$ „

increase. Consequently, to raise the temperature of a gas at constant pressure 1° C. requires, if the gas is at—

0°C. (273° absolute), as many caloric-units as are given in the table.
273°C. (546° absolute) half as many " "
546°C. (819° absolute) one-third as many " "

Gas contained in a close vessel, unable to expand, and therefore at constant volume, contains at all temperatures the same number of atoms, and therefore requires the same number of caloric-units to raise its temperature 1° C. as are given in the table.

The Properties of Steam.—Although steam for practical purposes is produced by the evaporation of water, it is useful for the investigation of its properties to consider the production of steam by combination of oxygen and hydrogen. By this means we are able to calculate in a very simple way, and to the highest degree of accuracy, the volume, weight, and pressure of steam due to any temperature, the temperature due to any pressure, the quantity of heat required to form steam of any pressure, the remarkable relation between the volume, pressure, and absolute temperature of steam, the quantity of heat theoretically required for steam and other heat engines working between definite limits of temperature, &c.

The results of these calculations agree perfectly with the results of Regnault's experiments; and by applying my specific gravities and specific heats to the calculation of the mechanical equivalent of heat, I find that oxygen, hydrogen, nitrogen, carbon vapour, carbonic oxide, steam, marsh gas, ethylene, carbonic acid, and other gases are all equally expanded by equal quantities of heat, and that the mechanical equivalent of 1 caloric-unit (C.U.) is 1393·14 foot-pounds = 773·96 foot-pounds per British thermal unit; and the equivalent of 1 metric C.U. = 423·864 meter-kilogrammes. The slight difference of these values from my former calculation of the mechanical equivalent of heat, as given in the article in the JOURNAL for March 13, 1888 (p. 466), are caused by the revised specific gravities and heats now used in the calculation. All these results I have laid down in graphic diagrams, which at a glance, without calculation, give much of the information required by the engineer and pyrological investigator and designer.

AMERICAN CANNEL FOR EUROPE.—Among the shipments of American coal which are now being made to Europe, the attention of gas engineers may be specially directed to the Breckenridge cannel of Kentucky, large consignments of which have already been sent over to this country and the Continent by the sales agents, Messrs. Perkins and Co., of New York. Very high claims are put forward for this cannel; one gross ton being, it is stated, equal to the production of 750,000 candle feet of gas and 26 bushels of a light and porous coke which will readily assimilate with that produced from the best caking coal. Apart from the large yield of 10,000 cubic feet of 75-candle gas, the resulting coke being a really merchantable article—a quality which is usually wanting in the solid residual from the carbonization of cannel—causes the Breckenridge material to compare very favourably indeed with enrichers employed in gas manufacture. This cannel is largely used in America; competing successfully with Australian shale in the Southern States.

THE LONDON COUNTY COUNCIL AND THE COAL DUES.—At the meeting of the London County Council last Tuesday, the Chairman of the Parliamentary Committee (Mr. C. Harrison) presented a report from the Committee on the subject of the coal dues. In the course of it they stated that inasmuch as, up to 1861, the duties of 8d. and 1d. derived from coal in the Metropolitan Police area were exclusively applied to improvements within the City, they considered the City has been already compensated by receiving moneys which had been raised outside its area to aid improvements within it; and expressed regret that the area outside the City had now been taxed 4d. per ton on all coal imported into the Metropolis for the year ending July 5, 1890, to relieve the City of liability incurred for local as distinguished from Metropolitan improvements, and that the surplus of the duties of the year 1889, to which the consumers outside the City contributed in the proportion of 9 to 4, should have been wholly diverted from the purposes and interests of that area to relieve a particular district.

ELECTRIC LIGHTING PROJECTS IN LONDON.—At the meeting of the London County Council last Tuesday, the Highways Committee reported that the Board of Trade had embodied in the Provisional Orders they had granted for the Metropolis a number of amendments suggested by the Committee. They further reported that notices of applications to be made next year for Provisional Orders had been received from the following Companies:—Chelsea Electricity Supply Company, for Kensington, and St. George's, Hanover Square. Electricity Supply Corporation, for St. Giles's, Strand, Paddington, and St. Martin-in-the Fields. House-to-House Electric Supply Company, for Wandsworth, Fulham, and Lambeth. The Laing, Wharton, and Down Construction Syndicate, Limited, for the City of London. London Electric Supply Corporation, for the area of which the Council is the local authority. Metropolitan Electric Supply Company, for certain streets and places to be hereafter specified. Messrs. Renshaw, King, and Co., for St. Margaret and St. John, Westminster. The Westminster Electric Supply Corporation, for St. Margaret and St. John, Westminster, St. George's, Hanover Square, St. Marylebone, and Paddington. A Company (about to be formed) for Hampstead, Paddington, St. Luke's, Shoreditch, Clerkenwell, St. Marylebone, Kensington, Islington, Bethnal Green, Fulham, Hammersmith, Whitechapel, and Hackney.

Technical Record.

VALON'S PREPAYMENT METER.

It may be remembered that the working of the scheme for extending gas supply to cottage consumers which has been introduced by the Corporation Gas Committee at Ramsgate, depends upon the operation of a prepayment meter invented by Mr. Valon, which is claimed to be much simpler in action and cheaper in first cost than any other device yet proposed for a similar object. The manufacture of these meters has been taken up by the Gas-Meter Company, and specimens of the apparatus are now being shown in action at the Company's works in the Kingsland Road; where the construction and working of the prepayment appliance was recently explained to us by the Manager, Mr. Andrews. The idea which underlies the apparatus is extremely simple, being merely to introduce into the train of wheel-work of the index a stop capable of being set in advance by a key at any desired figure, upon reaching which point the meter should cease to pass gas. The manner in which this idea has been worked out is very neat and apparently satisfactory. Very little difference appears in the face of the index to distinguish a meter of this kind from one of the ordinary construction, except that one of the dials has an inner concentric division bearing a pointer, which is capable of being revolved by hand in a forward direction by means of a key inserted in a hole in the top of the meter case. The understanding for the use of the meter is that an inspector shall receive from the consumer payment in advance for any agreed quantity of gas; and the inspector with his key sets the pointer of the check dial forward to the corresponding figure. He can then if thought desirable cover the keyhole with an adhesive seal bearing the company's private mark. When the meter has passed the stated quantity of gas it will stop, unless in the meantime the inspector has again called and set it forward in consideration of a further payment. There might, of course, be an arrangement whereby the consumer might break the seal and set on the meter himself, if regarded as a responsible person, in the unlikely event of the stated supply being exhausted before the inspectors' visit. This is, however, a matter of administration with which we are not at present concerned. In any case, as the other dials of the index register the total quantity of gas passed, just as in an ordinary meter, there is a perfect check against tampering with the key by the consumer. The action of the check dial does not interfere in the slightest degree with the ordinary registration of the gas passed. Simplicity can hardly go farther than this; and the cost of the additional mechanism is very little. This last consideration goes a long way to meet the requirements of gas undertakers, who although perfectly willing to experiment with a prepayment system, are not prepared to incur additional expense of a pound sterling or more for every small meter employed in this branch of their trade.

THE PERSONAL ERROR IN PHOTOMETRY.

A short time ago, Professor E. L. Nichols read before the American Institute of Electrical Engineers a paper on the above subject. The matter has already been briefly noticed in our columns; but although the paper deals with the photometry of electric lamps, it bears very much upon a question in which gas managers are interested, and therefore may be profitably dealt with at greater length.

Professor Nichols began by remarking that whenever in the course of photometric work different observers have occasion to compare the same pair of lamps, the results of their readings with the Bunsen photometer vary by an amount very much larger than the apparent mean error of a single observation; but no systematic attempt appears to have been made to determine the precise nature and importance of this personal error, the existence of which has doubtless been recognized by many photometrists. He had occasion lately to make some experiments in connection with this subject; and his results are striking. In conjunction with Mr. B. W. Snow he made sets of observations with the same pair of incandescent lamps under precisely similar and uncommonly favourable conditions. The two lamps were of similar type; and, being the only ones in circuit with a large storeage battery, they could be maintained at an almost constant voltage. The results of the readings are given in the following table; the figures exhibiting very clearly the existence of the personal errors of observation:—

Snow's Observations.					Nichols's Observations.				
Readings.		Differences.			Readings.		Differences.		
C.P.		C.P.		Per Ct.	C.P.		C.P.		Per Ct.
12·12	..	0·112 =	..	0·91	12·56	..	0·044 =	..	0·35
12·32	..	0·088 =	..	0·72	12·60	..	0·084 =	..	0·67
12·16	..	0·072 =	..	0·59	12·36	..	0·156 =	..	1·25
12·16	..	0·072 =	..	0·59	12·56	..	0·044 =	..	0·35
12·28	..	0·048 =	..	0·39	12·64	..	0·124 =	..	0·99
12·40	..	0·168 =	..	1·38	12·60	..	0·048 =	..	0·67
12·28	..	0·048 =	..	0·39	12·56	..	0·044 =	..	0·35
12·08	..	0·152 =	..	1·30	12·40	..	0·116 =	..	0·93
12·12	..	0·112 =	..	0·92	12·32	..	0·196 =	..	1·35
12·40	..	0·168 =	..	1·24	12·56	..	0·044 =	..	0·35
		Average.					*Average.*		
12·232	..	0·104 =	..	0·852	12·516	..	0·089 =	..	0·717

It will be seen from the above table that while the apparent mean error of a single observation is only about 0·1 candle, and the probable error of each set only 0·022 candle, the two averages themselves differ by 0·284 candle.

The following experiments were made for the purpose of determining the nature of this personal error:—Three incandescent lamps of the same type and voltage were selected, care being

taken to choose specimens the carbons of which were as straight as possible. These lamps gave the light of 16 candles at 110 volts. They were connected in multiple to the terminals of a storeage battery giving a potential difference of 120 volts. Adjustable resistances of German silver wire were placed in the line leading to each lamp, and in one of the mains leading from the battery. The lamps, with the resistances, were set up in a photometer-room which contained two Bunsen photometers. The connecting wires were of such length that the lamps could be moved from one photometer-bar to the other without breaking connections. One of the lamps was set up as a comparison standard at the end of the shorter bar. Each of the other lamps was then compared with this standard; the resistances being adjusted until these lamps were found to bear the same relation to the standard in regard to brightness. In other words, they were brought to the same intensity by a method which eliminated the systematic personal error which it was desired to study. The two lamps were then placed at the ends of the longer photometer-bar, the length of which was over 400 centimetres; and it was divided into 800 equal parts. The lamps had been measured with the planes of the filament at right angles with the bar; and care was taken, in setting them up in their new position, to place them at the same angle, so as to present the same face to the bar as before. In order to ensure greater constancy in the degree of incandescence throughout the series of tests, the lamps were maintained at a potential considerably below the normal; their power being about 12 instead of 16 candles. A number of observers (all accustomed to photometric measurements, and some who had had extended experience) were asked to make a set of ten readings each upon the two lamps. The results are given in the following table (I_r and I_l being the intensities of the right-hand and left-hand lamps respectively):—

Observer.	Ratio $\frac{I_r}{I_l}$	Personal Error.
A	1·0590 ± 0·0040	− 0·0558
B	0·9701 ± 0·0044	+ 0·0331
C	1·0021 ± 0·0022	− 0·0189
D	1·0191 ± 0·0072	− 0·0159
E	1·0182 ± 0·0039	− 0.0150
F	1·0902 ± 0·0057	− 0·0870
G	1·0783 ± 0·0053	− 0·0701
H	1·0293 ± 0·0042	− 0·0261
I	1·0297 ± 0·0050	− 0·0263
J	1·0220 ± 0·0027	− 0·1880

The true value of the ratio $\frac{I_r}{I_l}$ determined previously by comparing each lamp separately with the standard, was 1·0032 + 0·0015, which value was used in computing the personal error.

It will be seen from the figures in the table that none of the averages fall at the middle of the bar, nor are they distributed around it in such a manner that the most probable value of the entire series—calculated by least squares, under the assumption that only fortuitous errors exist—approximated to unity, as it should do were the lamps of equal brightness, and were there no systematic errors to vitiate the result. On the other hand, the readings lie, with a single exception, on one side—viz., to the left of the centre of the bar. It will be seen, moreover, that the probable error, calculated for each set separately, without taking cognizance of any systematic error, is very small in comparison with the differences between the mean results of the various sets, and especially in comparison with the variations of those averages from unity.

The Bunsen disc with which these observations were made was mounted in the usual manner; the two sides of the disc being viewed simultaneously by means of two plane mirrors set at the proper angle behind the former. It was noted that the almost universal habit in reading was to use the two eyes independently—one eye fixed upon each side of the disc. It seemed probable, therefore, that the personal error arose from the unequal sensitiveness of the observer's eyes, in that he would unconsciously set the disc at too great a distance from the lamp which illuminated the side which was being observed by his more sensitive eye. If we accept this explanation, it appears that the right eye was the more sensitive in all the cases under observation except one—that of Professor Nichols himself ("B" in the above table), whose readings would indicate the opposite peculiarity.

In order to reverse the relation of the observer to the photometer-bar, without altering any of the other conditions of measurement, a large mirror was set up opposite the photometer, at a distance of about 40 centimetres. The observer, by sitting with his back to the bar, could then see the images of the Bunsen disc in the mirror, and his right and left eyes were reversed with reference to the lamps. Sets of ten readings were made in this manner by some of the same observers as before; the object being to test the hypothesis which was just stated. The results thus obtained were, however, complicated by the unforeseen circumstances that the method of using the eyes in observation was not the same when the image of the disc was seen in the mirror as when it was viewed directly. The observer, when employing the mirror, no longer used his eyes independently, but scanned the image as a whole, so that both eyes had a share in determining the brightness of each side of the disc. The result was to produce a change in his settings, not by introducing a systematic error equal and opposite to that occurring in the first series of observations, as had been expected, but by eliminating the error in question. In a word, the settings with the mirror were in better agreement than those made by direct observation, and they gave results much more nearly in accordance with the known equality of the lamps.

In the Professor's own case, however, an exception to the above statement must be noted. Possibly as the result of an effort to repeat with the mirror the precise method of observation that was followed in making the direct settings, he continued to use his eyes independently; viewing the image of one side of the disc with the right eye, and the other with the left. There resulted a set of readings, such as he had expected to obtain from all the observers, the mean of which lay as far from the centre of the photometer-bar as the mean of the direct readings, but upon the other side. The results obtained with the mirror are given in the following table:—

Observer.	Ratio $\frac{I_r}{I_l}$	Personal Error.
A	1·0070 ± 0·0026	0·0028
B	1·0444 ± 0·0011	0·0414
C	0·9964 ± 0·0053	0·0068
F	1·0141 ± 0·0025	0·0109
G	1·0004 ± 0·0056	0·0028
H	1 0134 ± 0·0045	0·0102
I	1·0004 ± 0·0031	0·0028

The observations with the mirror were followed by four sets of direct readings made with one eye bandaged. It was found that, although more fatiguing, these monocular settings were made with a feeling of certainty on the part of the observer which had not accompanied the settings made with both eyes. In the latter case, indeed, a conflict between tendencies to set the disc in two distinct positions had been very apparent; the observer unconsciously choosing now one, now the other, as the true position. The set of readings, given in full in the following table, will serve to illustrate the result of this tendency; the instances in which the observer seems thus to have temporarily changed in his judgment of the true setting being printed in heavy type:—

No.	Reading.	No.	Reading.
1	1·033	6	**1·048**
2	1·022	7	**1·053**
3	1·021	8	1·023
4	1·023	9	1·033
5	**1·050**	10	1·030

This tendency to vacillation disappeared almost entirely when only one eye was used. The readings obtained with a single eye not only agreed much better among themselves than those made under like conditions using both eyes, but the results obtained with the left eye were identical with those obtained with the right eye, and both seemed to be entirely free from the systematic personal error that had been found to vitiate readings made in the usual way. The results of such a set of monocular readings, made by Mr. Snow and Professor Nichols (all other conditions remaining the same as in previous trials) are given in the following table:—

Observer.	Eye Used.	Ratio.	Personal Error.
B. W. S.	Right.	1·0028 ± 0·0019	0·0004
B. W. S.	Left.	1·0001 ± 0·0010	0·0031
E. L. N.	Right.	1·0001 ± 0·0017	0·0031
E. L. N.	Left.	1·0031 ± 0·0018	0·0001

It will be seen that the probable error of each set is much smaller than in the sets of observations made with both eyes; also that the readings of two observers, whose mean results from similar sets with both eyes had differed by 8 per cent. (see sets "A" and "B" in the second table), are in complete agreement. It will be noted that the results of these four monocular series differ from the accepted value of the ratio of intensities of the two lamps (1·0032) by an amount less than the probable error of each set.

It was the author's intention to extend to a much larger number of observers the experiments described in his paper. The evidence obtained, however, seemed quite sufficient to establish the existence of the personal error in photometry, and to show that it was in general very far from being a negligible quantity. Frequent repetitions showed that, in his own case at least, the error was very nearly constant; and he thought it would be quite possible to establish a personal equation, and to apply the proper correction. A much better plan, however, would be to so modify the photometer-bar itself as to ensure the use of both eyes in the inspection of each side of the illuminated disc. Several forms of photometer partially fulfil the necessary requirement. Professor Nichols considers that any device which would bring the images of the opposite faces of the disc into a vertical line in the field of view would doubtless serve to eliminate the error in question.

Observations with such a photometer would correspond in charac ter to the monocular readings given in the last table. Not only would they be free from the systematic error to which the ordinary form of Bunsen photometer is subject, but the accidental errors would be much smaller, and the degree of uncertainty which attends the determination of candle power by the present methods would be in great measure diminished.

THE CONSTRUCTION OF GAS-ENGINES.

At the last Meeting of the Institution of Mechanical Engineers, which took place recently in Paris, under the presidency of Mr. C. Cochrane, M. Delamare-Debouteville read a paper on gas-engines, in which he described the "Simplex" engine, introduced by him, in conjunction with M. Malandin, in 1884.

The author began with a historical review dating back to 1791, when Barber published the first description of a gas-engine; and stated that until 1860, when Lenoir brought out his engine, only 38 patents had been granted in France and elsewhere. Since then some 700 patents had been taken out. The four-cycle plan appears to have been suggested by M. Beau de Rochas; and the principle of compressing the charge before firing it was first adopted by Barnett in 1838. In his engine the mixture was admitted on both sides of the piston. He proposed to use a hollow cock containing a gas-burner. This cock had a revolving movement, whereby in one position it brought the burner into contact with an external flame, which lighted it, and in its further motion shut it off from the external air, and brought its flame into contact with the compressed gas in the cylinder. In the year 1844 Reynolds first suggested electric ignition, by means of a battery and incandescent platinum wire; and Shepherd in 1850, used a magneto machine for this purpose. In 1863, Hugon brought out his engine with slide ignition; and in 1867, the first Otto and Langen atmospheric gas-engine made its appearance at the exhibition which was then held in Paris. Bischoff followed in 1870 with his engines for small powers; and six years later began the remarkable development of the Otto engine. The author next entered with some detail into the construction of the original slide-valve, with ignition ports adopted in this engine, and pointed out that, owing to the fouling of the ports, the ignition was uncertain. The Lenoir system of ignition by means of a spark from an induction coil was also uncertain, on account of the electrodes becoming covered with moisture produced during the previous combustion, and thus losing their insulation. Ignition by a heated tube, which was suggested by Funck in 1879, was fairly successful with rich gases, but uncertain with weak ones; the heat of the tube being always inferior to that of a flame or a spark. The tube could not be made thick on this account, and it wore out very rapidly. A hot platinum wire was subject to the same objections as the tube, of being cooled by the expansion of the gases, and therefore giving an uncertain ignition. After trying various modifications of these different means, the author adopted in his engine a combination of the ignition-slide and electric spark, which gave perfectly reliable ignition.

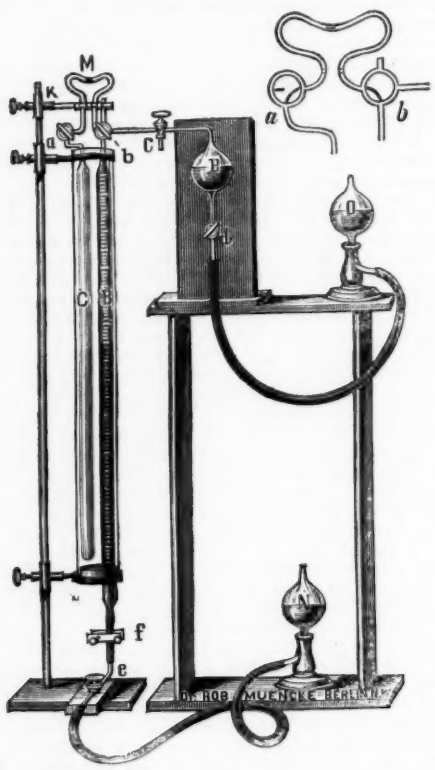
The author then proceeded to describe his engine, which is specially intended for use with poor gas. The ignition is effected by a continuous spark produced by an induction coil and battery; the electrodes being placed in a cavity of the slide, so that the moment of ignition is determined by the position of the slide, and is thus under perfect control. The engine works on the four-cycle plan; and the air and gas are mixed in an external receptacle fixed on the cover of the slide, and are drawn in through a channel of varying section. Two methods of governing are employed in the engine, according to the nature of the work for which it is intended. For locomotive purposes the author uses what he calls an air governor, which is actuated by the air pressure produced by a small pump worked from the slide-rod. For stationary purposes a pendulum governor is employed. The lower arm of the pendulum is provided with a notch, which at normal speed engages with the knife-edge of a trip-lever actuating the admission-valve. When the engine runs too fast, this trip-lever, which is carried to and fro with the slide, moves faster than the pendulum; and the latter therefore fails to put it into such a position as to engage with the stem of the admission-valve. The arrangements for starting these engines are also novel. Engines of small size may be started in the usual way; but larger engines would require too many men to turn them by hand, and some special provisions have therefore been introduced. For an engine of 16-horse power, for example, a small gas-pipe, furnished with a three-way cock, is fitted on the igniting apparatus. An admission passage for gas traverses the barrel; and a small hole of suitable section, communicating with the outer air, is pierced in this passage. An india-rubber tube connects this gas-pipe with the gas supply of the engine; and at the point of junction is fixed a small graduated gas-cock, the degree of opening of which regulates the proportions of the explosive mixture. The induction coil is fitted with a contact breaker, which interrupts the flow of sparks between the platinum points. When this is done, the three-way cock is first opened, and then the gas-cock to the marked position. The fly-wheel is slowly turned to draw in the explosive mixture; and when the piston has made two-thirds of its stroke, the three-way cock and the gas-cock are closed. Then the plug of the large gas-cock used when the engine is running is turned, and set at the position convenient for starting. The fly-wheel is moved backwards to compress the charge, the current switched on, the spark produced, the charge ignited, and the fly-wheel receives an impetus sufficient to start it. In engines above 20-horse power a small cock is fixed on the cylinder above the compression chamber, forming a communication between its interior and the outer air. The engine must be stopped with the crank at an angle of 90°, which is easily accomplished by means of a three-way cock. The piston has then made about one-half of its stroke. The gas-cock is opened to the marked position, as before, as is also the three-way cock. As the gas is under slight pressure, it enters the cylinder through the seating, and draws in air with it by a small oblique hole. The explosive mixture thus formed gradually fills the space behind the piston, expelling the burnt gas by the cock at the top of the cylinder, which must be opened previously to that for the admission of the gas. In about a minute, for a 50-horse power engine, the cylinder is full of explosive gas; and the cock above the cylinder, the gas-cock, and the three-way cock are then closed. As before, the large gas-cock is opened to the starting position, the current switched on, the charge ignited, and sufficient impetus given to the fly-wheel to start the engine. The "Simplex" engine has been tested with coal gas, Dowson gas, gas from Lencauchez generators, petroleum vapour, and wood gas; and with all of them it is stated to work equally well. In spite of the high initial pressure to which the explosive mixture is subjected, the working is easy and noiseless. This result is attained by determining the point of ignition not at the dead point, as proposed by Beau de Rochas, but somewhat later, when the piston has already made part of its forward stroke. An engine with a $7\frac{7}{8}$-inch cylinder and $15\frac{3}{4}$-inch stroke was tested by Dr. A. Witz with lighting gas and Dowson gas. With the former the work done on the brake was 6·70-horse power; and the consumption of gas was 21·55 cubic feet per horse-power hour reduced to atmospheric pressure and 32° Fahr. temperature. In another trial the consumption was 20·12 cubic feet. With Dowson gas the work done was 7·12-horse power, and the consumption of gas 88 cubic feet per horse-power hour. A 50-horse power engine, working at from 35 to 40 horse power, consumed daily with a Dowson generator 51 lbs. of anthracite, being equivalent to a consumption of from 1·178 to 1·30 lbs. of fuel per horse-power hour; whilst a 16-horse power engine working with coal gas, and developing 12-horse power, required 19·4 feet per horse-power hour.

In the discussion which followed the reading of the paper, Mr. Macfarlane Gray, who had seen these engines running at the maker's works in Rouen, said he could speak well with regard to their construction and general working. He was particularly struck with the very beautiful and efficient action of the pendulum governor. The President drew attention to two points mentioned by the author as necessary in the construction of a good gas-engine. The first was that economy could only be obtained by the employment of compression before the charge was fired; the second, that absolute certainty of ignition could only be ensured by means of the electric spark. On these two points he understood the author laid the greatest stress; and he hoped the members would give their opinions on them. Mr. H. Smith criticized the paper rather adversely. In the first place, he found fault with the historical part, because the author had only given an incomplete account of the successful engines, and had neglected to mention any of the other engines made in England besides the "Otto." Referring to electric ignition, where the current is produced by a little dynamo, he mentioned an ingenious arrangement he had seen. The dynamo was driven by friction gearing from a small pulley on the engine-shaft; but a large pulley was also fitted, and the dynamo was so arranged that it could be driven from this large pulley when starting. By this means the necessary speed of the dynamo could be obtained, even when turning the engine slowly by hand. He next gave a description of the "Forward" gas-engine, in which the regulation of speed and power was obtained in two distinct ways. For small variations of power, the strength of the charge was altered by the governor acting upon the gas-admission valve; whilst for large variations, the gas supply was completely cut off. He had witnessed some tests in which a 4-horse power engine was loaded to 6-horse power, and its speed counted. At a given signal the load was knocked off; and the increase of speed was only 2 per cent. Professor Kennedy did not agree with the author in his condemnation of the ignition-tube. This appliance was, he said, used by several of the best English makers. The governing in modern engines was performed by changing the strength of the explosive mixture when the variation of power was small; but when it was large, the engine was governed by the hit-and-miss plan. He thought the pendulum governor of the author a very pretty and ingenious arrangement. Mr. Maw pointed out that the ignition-tube could not be so objectionable a feature in gas-engines as the author had endeavoured to make out. At the Windsor Show of the Royal Agricultural Society, he had seen several engines provided with such tubes. Mr. H. Shield said he was satisfied with the ignition-tube; and Mr. Beaumont expressed the opinion that the tube was a perfectly satisfactory device. M. Delamare-Debouteville, in reply, said the particular method adopted by him was the outcome of a long series of experiments; and although he did not deny that English engineers had found the ignition-tube a practical device, he, at any rate, found it unreliable when using poor gas. The system of ignition adopted by him had also the advantage of enabling him to regulate the time of explosion with the greatest nicety; and he was thus able to fire the charge after the crank had passed the dead point by about 15°, and when the piston had already acquired a certain velocity. This method of working, although on theoretical grounds it might appear rather

objectionable, gave in practice better results than the method of firing the charge at the dead point, which was necessary with the tube ignition. The reason he did not include in his paper all the modern gas-engines was that his own was an improvement on the "Otto" and "Lenoir" engines; and therefore it was unnecessary to describe the engines of other inventors.

DREHSCHMIDT'S GAS-ANALYSIS APPARATUS.

In the JOURNAL for the 25th ult. we described and illustrated some new forms of apparatus for the analysis of gas. We now give a few particulars of an instrument which has been devised for this purpose by Herr H. Drehschmidt, Chemist to the Berlin Municipal Gas-Works. Like Patterson's and Hempel's apparatus (both of which are doubtless known to our readers) it is constructed so as to facilitate the analysis of gas by avoiding the inconvenience of making corrections for variations in the temperature and pressure of the atmosphere. In consists of a measuring-tube B (connected below, with an intervening stopcock and screw-clip *f*, with a movable reservoir of mercury N) and a compensation-tube C enclosed in the same glass cylinder. These two



tubes are connected at their upper ends by means of a capillary tube, which is bent so as to form a differential pressure-gauge M. At the top of the compensation-tube there is a stopcock *a*, which is pierced in such a way as to permit of connecting the pressure-gauge with the compensation-tube, or either of them with the external air, or shutting them both off. At the top of the measuring-tube there is another stop-cock *b*, pierced once so as to connect any two tubes situated at right angles to each other. By this cock the measuring-tube and the pressure-gauge may be put in connection with one another or with the external air. The stopcocks *a* and *b*, with the bent tube forming the pressure-gauge are shown on an enlarged scale in the small illustration.

Gas for analysis is admitted in the usual way, and allowed to nearly fill the measuring-tube. The level of the mercury in B is then raised to the desired point, the water in the cylinder is well stirred up, and a portion of the gas allowed to escape by opening the stopcock. The level is next accurately adjusted, and a momentary connection made with the air, so as to remove any excess of pressure. The measuring-tube is then put into communication with the pressure-gauge, which at the same time is connected with the compensation-tube (the latter having just previously been opened to the air). The position of the bubble of coloured liquid (which may be coloured concentrated sulphuric acid or heavy petroleum oil) in the pressure-gauge should be carefully noted, so as to bring it to the same position throughout the analysis. For absorptions, the gas is transferred by means of cocks and a moveable reservoir of mercury to a suitable pipette, into which the reagent has been previously admitted through a three-way cock *c*. For the determination of the amount of combustible gases present, the author finds that these may be completely and safely burnt with oxygen diluted with nitrogen in a platinum tube 20 centimetres long, 1 millimetre in diameter, and ½ millimetre thick, in which are placed three or four thin pieces of platinum wire. This tube is soldered at each end to a piece of brass tubing. In use, it is placed between the measuring-tube and the pipette; being connected to them by india-rubber tubing. During use it is heated by a flat-flame Bunsen burner; the temperature being raised higher the more difficultly combustible the gas under examination is. The diffusion through the platinum is found to be insignificant.

The author prefers hollow stopcocks with capillary tubes fused in them, to solid bored stopcocks.

THE ESTIMATION AND OCCURRENCE OF SULPHUR IN COAL.

At a recent meeting of the Manchester Section of the Society of Chemical Industry, Dr. G. H. Bailey read a paper on the above subject. He examined the various methods in use for determining sulphur in coal, and found that those dependent upon oxidation by chlorate or nitre gave results that were invariably too low. The use of large quantities of chloride of soda, nitre, and carbonate of soda was objectionable, as likely to induce error—the presence of only 0·1 per cent. of sulphur in the reagents being capable of causing an error of as much as 20 per cent.—and also because the presence of large quantities of alkaline salts in a solution interfered with the complete precipitation of barium sulphate. Oxidation by means of aqua regia was unpleasant to work, and also yielded low results. Eschka's method was found to give constant and trustworthy results, always within 1 per cent. of the mean; and it was also simple. An intimate mixture of two parts by weight of magnesia and one of sodium carbonate (both free from sulphates) was prepared. Two parts by weight of this mixture were carefully stirred in with one part of the coal or coke to be tested, in a platinum crucible. This was very gently heated over a Bunsen burner, and the temperature gradually increased, but never more than sufficient to bring the bottom of the crucible beyond visible redness. This operation usually occupied about two hours, and was finished when the whole mass had become white or light gray, with no black specks. It was then exhausted with water, the clear solution warmed with a little bromine water (free from sulphuric acid), acidulated with hydrochloric acid, and precipitated by means of barium chloride in the usual way.

Mr. Crace Calvert supposed that sulphur exists in two forms in coal—as sulphates and as sulphur in other forms; and that only the latter portion would appear in the chimney gases. He proposed to extract the sulphates by digesting the finely powdered sample with a strong solution of sodium carbonate, and the other forms by oxidation with aqua regia. If Eschka's method was substituted for the latter, better results would be obtained. Some samples of coke residues from the destructive distillation of oil, tested by the magnesia method, showed 0·565, 0·605, and 0·815 per cent. of sulphur respectively. Another analyst, using the chlorate method, gave results below 0·25 per cent. A sample of coal contained 2·72 per cent. of sulphur by the magnesia method, 2·67 per cent. by Crace Calvert's method modified, 2·47 by Crace Calvert's method, 2·14 by chlorate, and 2·04 by nitre. Another sample gave 0·13 of sulphates, and 2·08 per cent. of sulphur in other forms by Crace Calvert's method; but with the magnesia, the latter was increased to 2·51 per cent. Three separate determinations on another sample tried by Crace Calvert's method modified gave closely approximating results—averaging 0·27 per cent. of sulphates, and 3·81 per cent. of sulphur in other forms.

The results of some experiments made at Messrs. Bryan Donkin and Co.'s works, at Bermondsey, with a view of finding out how far the actual results in practice, as shown by analysis of the chimney gases and also of the ash, agreed with Crace Calvert's rule, were referred to. In the sample of fuel last named (coke breeze), 5·4 per cent. of the sulphur was found in the ashes, 55 per cent. in the chimney gases, and 39·6 per cent. was unaccounted for. Very similar results were obtained with Welsh and with Newcastle coal—viz., about 5 per cent. in the ash, 53 per cent. in the gases, and 42 per cent. unaccounted for. From these results, it appears that the sulphates do remain with the ash. The 40 per cent. of sulphur unaccounted for must have been deposited in the flues or on the boiler plates; and this shows that the sulphur in the fuel is not a matter to be disregarded in boiler heating. A large quantity of the sulphur was retained by the flue dust; several samples containing as much as 15 to 20 per cent.

Some samples of coal were subjected to dry distillation. In certain cases very little sulphur came over in the earlier stages of the distillation; whilst in others a great deal was evolved at this period. The percentage of sulphur remaining in the coke varied considerably. Two samples of coal of a very similar character in regard to ash, yield of coke, and relation of sulphur as sulphates to sulphur in other forms, containing respectively 1·83 and 1·10 per cent. of sulphur, gave 58 per cent. and 73 per cent. of the total sulphur in the coke. The first-named contained much oxide of iron in the ash, and the latter very little. There were two coals, one of which gave off 42 per cent., and the other 27 per cent., of its sulphur with the volatile matters; and this opened up a question of considerable importance in the manufacture of coal gas. This matter was worthy of further investigation, especially in regard to whether the sulphur appeared in the gas as the readily removable sulphuretted hydrogen, or in other forms that were not completely got rid of by the usual process of purification.

In the course of the discussion that followed the reading of the paper, Mr. P. Hart suggested that some of the sulphur might pass away in combination with ammonia or with hydrocarbons.

Also that Mr. Davis's method of estimating the sulphur in spent oxide—by combustion in a gas-furnace, and absorbing the sulphurous acid by hydrogen peroxide—might be applicable to fuels. Mr. Watson Smith drew attention to M. Brullé's method of using a long narrow platinum boat covered with a sliding lid, which had the advantage of holding all the mixture in a thin layer. A little chlorate of potash and nitre was strewn on the top of the mixture, the cover put on, the whole introduced into a combustion tube, and the space above the cover packed with some of the mixed salts. The tube was heated in the usual way, after which the mixture was precipitated. M. Brullé objected to the ordinary methods, and especially to combustion in a crucible, as likely to cause loss of sulphur. Mr. J. E. Holgate had used the lime process regularly for eight or nine years, for estimating sulphur in coke for blast-furnace use, and found it highly satisfactory. The sample was mixed with 1 to 1½ times its weight of pure lime, made into a paste with water, dried at a moderate heat, and ignited in a muffle at a good red heat until all the carbon was burned off, which usually took from 30 to 60 minutes. After cooling, it was transferred to a beaker, dissolved in dilute hydrochloric acid, heated to boiling point and filtered. Most of the free acid was then neutralized with ammonia, and the sulphuric acid precipitated in the usual way. A little bromine water was sometimes employed; and a small quantity of fresh lime might be sprinkled over the mass previous to ignition, to avoid loss of sulphur.

Dr. Bailey, in replying, did not accept Mr. Hart's suggestion, as he thought the sulphur would be retained by the potash in the ash. He believed the lime process was as accurate as the magnesia; but considered the latter to be preferable, as not requiring the addition of acid, and also as being conducted at a lower heat.

The Revised Railway Rates for Coal.—We learn from Mr. J. Deakes, of Worcester, that considerable support has been promised by gas companies and gas-supplying corporations to the movement now on foot to prevent the proposed abolition by the railway companies of the rebate on gas coal. An augmentation of the number would, however, be a powerful factor when the matter comes before the Railway Commissioners: and therefore it it is to be hoped that other bodies interested in this question will at once strengthen the hands of those who have taken up the matter, by joining those who have already signified their approval of Mr. Deakes's action.

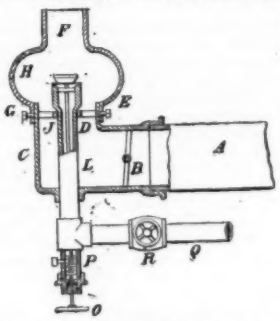
London Gas Stokers and the Eight Hours Movement.—We learn from the *Labour Elector* that at a meeting of gas stokers held at Lower Sydenham on the 7th inst., a resolution was passed thanking the Directors and Engineers of the South Metropolitan Gas Company for conceding the eight-hour day—a compliment which our contemporary says these gentlemen thoroughly deserve. In noticing this matter last week, we stated that the only hitch in the settlement of the dispute between the Directors of The Gaslight and Coke Company and the stokers was caused by a difficulty at Nine Elms. We learn from the above-named source that this was in no way attributable to the Resident Engineer (Mr. J. Methven); while with regard to the Fulham station, the men have expressed the highest appreciation of the conduct of Mr. M'Minn in this matter. The stokers are all very elate at the success which has attended their movement; and we believe they purpose holding a mass meeting in Hyde Park on Sunday the 28th inst. to celebrate the event.

Great Storm and Damage to the Gas and Water Supply Plant in Hong Kong.—As the result of a terrific rainstorm, accompanied by thunder and lightning, which burst over Hong Kong on the 29th of May last, considerable damage was done to both the gas and the water distributing plant. Such was the deluge of water, that the gas-mains were entirely flooded, and the supply cut off. Consequently, in addition to the troubles incidental to the storm, many of the inhabitants had to bear the inconvenience of using oil-lamps and candles. By prompt and energetic action, however, on the part of the Gas Company's Manager (Mr. F. W. Cross), a portion of the city was lighted on the night of the storm, and other parts as soon as a fractured main had been temporarily repaired. The rain began to fall at 7 o'clock in the morning; and continued in an uninterrupted torrent till midday. The enormous quantity of additional water which poured into the service reservoir used for supplying the city, filled it to overflowing, and a perfect cataract flowed from it on one side. Owing to the great rush of water, the sloping earth backing the wall of the reservoir at this point was speedily torn away, and the wall left exposed and unsupported. The reservoir itself became partly filled with mud, rendering the water useless for consumption; but while this caused inconvenience in one way, it was advantageous in another, inasmuch as the storeage capacity of the reservoir was thereby reduced, and the pressure of water relieved. Several serious rents were caused in the walls; and it was at one time thought that the whole structure would give way. Happily this did not occur; and fortunately the filter-beds escaped damage, so the supply of water to the city was kept up from them. It is scarcely necessary to allude here to the devastation caused by this great storm, which lasted altogether 36 hours, during which period something like 30 inches of rain (about equal to the average for an entire year in the British Islands) came down. It is estimated that the volume of water which fell over 32 square miles of the city and its watershed would give 20 gallons per head to the entire population of Hong Kong for twelve months.

Register of Patents.

Fuel Gas-Burners.—The Gas Patents Syndicate, Limited; communicated from J. B. Archer, of Washington, U.S.A. No. 8560; June 11, 1888. [6J.]

This invention relates to apparatus for burning gas as fuel for boilers or furnaces, in which apparatus a gas-induction pipe leads into an air-induction pipe having a jet orifice at which the mixture of air and gas is burned; and the object of the invention is to secure, by a simple and convenient arrangement, a thorough mixture of the air and gas before they issue from the burner—thereby obtaining complete combustion with a convenient means of regulating the supply of both the air and gas.



In the illustration of a burner according to this invention, partly in section, A is the air-supply pipe, provided with a regulating-valve B, an elbow C beyond the valve, and then a neck D, fitting closely within the collar E of a bulb H, held by set-screws G. The bulb is contracted at its outer end to form a nozzle F of less width than the air-pipe A, on which nozzle a jet-pipe I (which may be of the multiple form shown) can be fixed either directly or with interposed reducers. Through a central ring of cross ribs J, and through a boss on the side of the elbow C, is passed tightly a gas-pipe L, the end of which opens as a jet in the chamber of H. The interior of the gas-jet is larger than the gas-pipe, with a trumpet-mouth, and a conical spreader, which can be closed, as a valve is fixed on a spindle, which extends through the pipe L, and terminates in a hand-wheel O. The spindle is screwed through a nut at P; so that, by turning the wheel, the spreader can be adjusted to and from the mouth of the jet. When it is more or less open, it acts (in conjunction with the trumpet-mouth) to deflect the issuing current of gas outward on all sides within the chamber H, and thus causes the gas to be intimately mixed with the air passing through the chamber to the contracted nozzle F. The gas-pipe L is connected with a gas-supply pipe Q, provided with a regulating-valve R. By adjusting the gas and air supply valves R and B, and the gas spreader, with relation to each other, a flame of greater or less power may be obtained at the burner jet F.

Continuous Carbonization of Coal.—Elliott, J., of Ludlow. No. 11,443; Aug. 8, 1888. [11d.]

This invention relates to improvements upon an invention patented in 1887 (No. 5519).

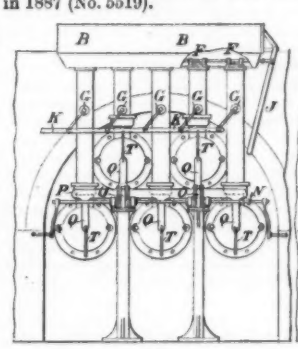


Fig. 1.

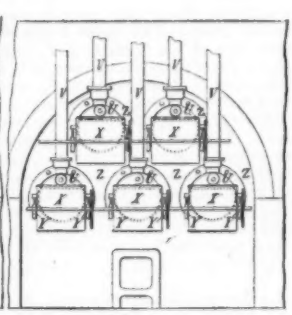


Fig. 2.

Fig. 3.

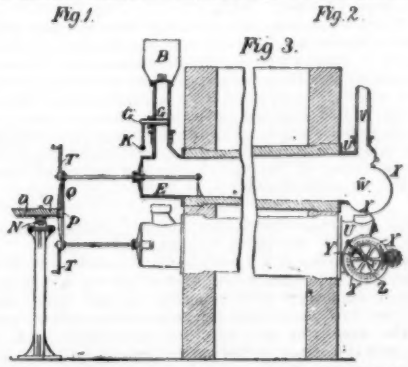


Fig. 1 is a front elevation, fig. 2 a back end elevation, and fig. 3 a section representing a bench of retorts with some of the present improvements applied thereto. Fig. 4 (next page) is a front elevation, and fig. 5 a section, showing improved means for simultaneously rotating the scoops of a bench of retorts.

The retorts may be of the ordinary character, or (as shown) they may

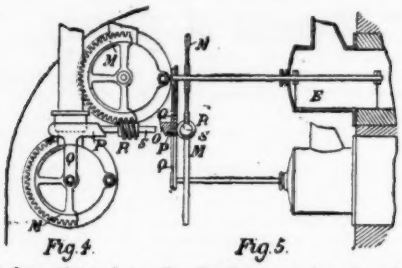


Fig. 4. Fig. 5.

be larger at the outlet end, to allow for the expansion of coal during the process of carbonization. B is a small open hopper for containing a quantity of coal, connected to the mouthpiece of each retort by a pipe. These pipes are provided with an arrangement to prevent the escape of gas whilst coal is being let into the scoops or chargers E inserted in the mouthpieces. The arrangement for each pipe consists of a gas-tight cover F, working on a true surface fixed on the bottom of the hopper B, and a coal regulator G, consisting of a simple plate loosely fitting the interior of the pipe. The covers F are connected by a rod, so that, on pulling the lever J, they simultaneously open or close all the pipes D; or the covers may be moved by a screw. The regulators G, which only require a quarter turn to open on full, may be opened separately by means of levers fixed on their axes, or they may be all opened simultaneously by connecting the levers to a rod K. The scoops are each fixed to a rod passing through the lid of the retort; and this rod has a lever T attached to the other end, by which each scoop may be separately operated. Or, according to the present invention, there is fixed on each of such rods a semi-circular toothed wheel M, (or it may be a cam) geared to worm-wheels R, fixed to the shafting S, as shown in figs. 4 and 5.

The scoops are thrust into or withdrawn simultaneously from the retorts by means of a cross bar P, having as many arms Q as there are retorts in the setting. Each scoop rod passes through an opening near the extremity of its respective arm, so that, on the shaft N being made to revolve, the pinions will operate on the racks O attached to the cross bar, and cause the cross bar, and consequently the scoops, to advance or recede.

To the opposite or back end of the retort, there is also a kind of mouthpiece U (a tailpiece), from which the ascension-pipe V rises. This tailpiece is provided with a handhole for cleaning the ascension-pipe; and also an opening W, which corresponds with an opening in the short cylinder X that is pivotted to arms Y attached to it. The tailpiece is made to a curve of a true circle; so that, when the cylinder X is brought up against it, it may turn, though in close contact with the facings of the tailpiece, and ensure a gas-tight joint. The openings in the cylinders may be exposed for the discharge of coke, by a handle attached to the axis of each cylinder X, or the whole may be actuated simultaneously by means of cogged wheels, fixed to the shaft, and geared into other toothed wheels Z attached to the cylinders. The bearings of the cylinders X are mounted in slots in the arms Y, and are there supported by springs which keep the cylinders in close contact with the tailpieces.

The action of the apparatus is as follows:—The hopper B being charged with coal, the covers F are withdrawn from the tops of the retort-pipes. The coal then falls till it fills the space between F and G, which, when full, contains a fixed quantity of coal. The covers F are returned till they close the openings at the top of the pipes. The regulators G are then opened, whereupon the coal will fall into the scoops below. The scoops E are then thrust in their full length by the operation of the racks O and pinions N; and the scoops are, according to the arrangement shown in figs. 1 and 3, turned over by means of the levers T, or, according to the arrangement illustrated in figs. 4 and 5, they are turned over simultaneously by revolving the shaft S. The coal will thus be deposited on the bottom of the retort, ready for carbonization. The rods are then drawn outwards; and the scoops returned to their former or normal position. After a short interval, to allow the coal to become caked, the scoops are again charged with coal, forced forward, and turned over; and in thrusting forward the second charge of coal, the coal already introduced will be pushed towards the opposite end of the retort, and by repeating the operation, the coal which has been converted into coke will fall through the opening in the tailpiece into the cylinder X.

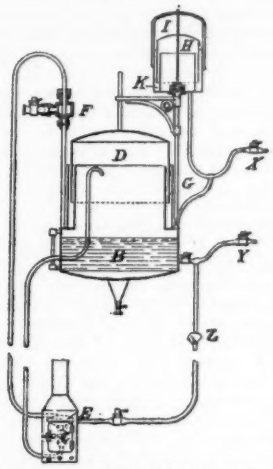
GAS REGULATORS OR GOVERNORS.—Beard, R. R., of Bermondsey. No. 13,181; Sept. 12, 1888. [6d.]

This invention is for automatically controlling the flow and pressure of gas; and is particularly applicable to gas regulators where a chamber or bellows is lifted according to the pressure of the gas within it, causing a valve for admitting the gas to open or close according to the direction in which it is moved. This is accomplished by a series of levers or rods jointed together in the form known as lazy-tongs; one end of the series of levers being connected to the moveable chamber or bellows, the other end terminating in eccentrics, which oscillate on a pin fixed to the frame of the regulator or to a portion of the regulator other than the moveable chamber.

CARBURETTED AIR GAS.—Armstrong, G. P.; communicated from G. Jaunez, of Paris. No. 7854; May 10, 1889. [6d.]

This is a modification of a French patent granted to M. Moussard in 1869 (No. 88,263), the main principle of which was the heating of the volatile liquid employed until vaporization, and then utilizing its expansive force to draw in the air to be carburetted by means of an injector. The apparatus was, however, complicated, and its action unreliable; and the object of the present invention is to reduce all the parts of the apparatus to their simplest form, while at the same time improving them fundamentally.

In order to start the apparatus shown in elevation (part section), there is introduced a given quantity of carburetted liquid from a reservoir into the trough B by means of the tap Y; and the burner C is then lighted. This burner is, at the commencement of the operation, fed by



a small quantity of carburetted air, which is formed cold under the receiver D. When lighted, the burner heats the carburant, which passes into the vaporizer E from the trough B, through the pipe Z; and the gas then flows through the carburetter F, where, by means of a Giffard injector, it draws in the air, which is thereby carburetted, and is then driven into the receiver D, which rises as the quantity of gas therein increases. The carburetted air gas passes through a pipe G to the pressure regulator H; and thence through a cock X to the supply burners. The pressure regulator is composed of a small receiver working in a tank with a hydraulic joint This receiver is furnished with a rod and equilibrium valve, which opens and allows the passage of the gas according to the rate of consumption; so that a constant pressure is maintained under the receiver I, and the gas passes to the consumers at constant pressure, without allowing the burners to leak at any rate of consumption. When consumption ceases, the gas collects under the receiver I, which rises and closes the valve.

APPLICATIONS FOR LETTERS PATENT.

10,597.—GRISWOLD, H. J., "Improvements in electrical apparatus for lighting gas." July 1.

10,598.—VALON, W. A. M'I., "Improvements in stop indices for prepayment gas-meters." July 1.

10,634.—BULL, J. C., "Improvements in petroleum or other explosive vapour or gas engines." July 1.

10,672.—CHRISTIANSEN, C., "An automatic liquid meter and tap." July 2.

10,700.—ROCK, J. W., MOORE, C. G., WOOD, J. H., and NICHOLSON, J. B., "An improved gas-making apparatus." July 2.

10,717.—BLUM, J., "A gas power generator." July 3.

10,773.—HEALD, A., "Improvements in gas-lamps." July 3.

10,829.—STEENBERGH, B. VAN, "Improvements relating to the manufacture of gas and to apparatus therefor." July 4.

10,831.—LEIGH, H. H., "Improvements in compound gas or petroleum engines." A communication from P. F. Forest and G. Gallice. July 5

10,834.—WRIGHT, W., "Improvements in the construction of multiple burners for heating purposes." July 5.

THE USE OF GAS-STOVES.—An exhibition of gas-stoves and appliances has been held in Swansea by the Gas Company; and lectures illustrating the advantages of these over ordinary stoves were delivered by Mrs. Thwaites, of Liverpool. In introducing this lady on the first occasion to the audience, the Secretary and Engineer of the Gas Company (Mr. Thornton Andrews) quoted statistics to show how gas-stoves were appreciated elsewhere. It appeared that after twelve months 1300 were in use at Bristol. There were 4000 employed at Leicester; 3000 at Birmingham; 2000 at Belfast, and 1100 at Coventry; while the South Metropolitan Gas Company had a standing agreement with the makers for the delivery of 180 a week. A great convenience, he said, was that those anxious to use these stoves were not required to purchase them outright; but could hire them at from 1s. 6d. to 4s. a quarter.

THE LIGHTING OF DUBLIN.—At the meeting of the Dublin City Council yesterday week, Mr. Dennehy, in accordance with notice (*ante*, p. 85), moved that the question of the public lighting be referred to the Paving and Lighting Committee. He said that complaints had been made by the citizens, and had appeared in the Press, that the public lights had been latterly extinguished some hours before the usual time, the result of which had been that the streets during those hours had been left in utter darkness. By this system, which had been recently adopted by the Gas Sub-Committee of the Paving and Lighting Committee, the lives and the property of the citizens, he alleged, had been jeopardized. Mr. Doherty seconded the motion. Alderman Parry said the existing practice in regard to public lighting had been followed since 1867. A minute book of that date showed that on June 27, the extinguishing of the lamps began at 1.10 a.m., and was completed at 2.10. The hours of lighting were longer in Dublin than in any other city in the three kingdoms. In Belfast in the month of June, the lamps were all lit at 10.40 p.m., and the extinction commenced at 1 a.m. The hours of lighting and commencing to extinguish at the same time of the year in Cork were 10 p.m. and 1 a.m.; in Glasgow 10.45 p.m. and 2 a.m.; and in Limerick on moonlight nights the lamps were extinguished at 11 p.m. The motion was negatived. Mr. Dennehy then proposed that the Committees which had been appointed during the past year with reference to gas and electric lighting matters should furnish full reports to the Council on these subjects, with the least possible delay. Mr. Little seconded the proposal, which was also negatived. The third motion of which he had given notice was then brought forward by Mr. Dennehy—"That a resolution of the Council, passed on the 1st inst., approving of the expenditure of £3000 on the erection of a building for the testing of gas-meters be rescinded." Mr. Little seconded the motion, which was also lost.

Correspondence.

[We are not responsible for the opinions expressed by Correspondents.]

MR. BRAY, MR. EASTWOOD, AND THE GAS INSTITUTE.

SIR,—On the 25th ult. you published a report that had been supplied to you of the proceedings of a meeting in connection with the proposed "National and Representative" Gas Managers' Association.

One of the speakers at that meeting was Mr. C. Eastwood, of Liverpool, who, alluding to the proceedings at the recent annual meeting of The Gas Institute, is reported to have said—

"The other rules were then taken in hand; and there seemed to be a wonderfully unanimous feeling to pass a rule which would place every member, associate, extra-ordinary member, or any one else, thoroughly within the power of 50 sensible men to exclude him. It was scarcely possible to point out the bearings of this Rule 25 without alluding to a certain person who obtained a perpetual injunction which prevented the old Gas Institute from expelling him. This rule, as amended, gave power to a meeting of 50 persons to expel any disorderly person by a majority of one. Wishing, as far as possible, to prevent the formation of a new one, if they could possibly reform the old one so as to make it come within the scope of their wishes, he induced Mr. Bray, in the presence of witnesses, to vote for Rule 25, by which means he submitted himself to the ruling of 50 members at any meeting, and thereby put himself out of court for ever in any attempt to enforce the injunction This injunction applied only to a certain state of things which now no longer existed; and, he had, by his own vote, acquiesced in the new rule. Under these circumstances, the power to deal with obstructionists was entirely altered."

As Mr. Eastwood has informed me that the report just quoted is practically correct, permit me to say that he did not "induce" me to vote for Rule 25. He never tried to "induce" me to vote for it. As a matter of fact, I did not vote for the rule when it was put for adoption.

But Mr. Eastwood did try to induce me to do something else. Immediately after Tuesday morning's meeting, Mr. Eastwood came to me in Great George Street, and asked me what I intended to do in regard to the Council's resolution for the relegation of myself and the other "extraordinary members" to lower grades in the Institute. I invited Mr. Eastwood to lunch with myself, Mr. Sellers, and Mr. Hill; and we talked the matter over together. Mr. Eastwood said he was aware that I held the key of the situation, and that the Council's proposal would be a breach of the injunction I had obtained, and otherwise illegal, and could not be acted upon without my consent. Yet he urged me again and again to vote for the resolution, and solely on the ground that if I would agree to the relegation of traders to the non-voting classes of the Institute, it would take away the pretext—namely, a desire to effect a severance between gas managers and the "trading element" (specious as he admitted it was)—which those who were endeavouring to form a rival Institute advanced as the sole justification for their action. I expressed my desire that nothing should occur to destroy or damage the Institute; and said that on the previous evening Mr. Sellers, acting on a suggestion of his own, but with my entire approval, and with the object of averting the calamities which the Council's proposal would be sure to bring about, had had an interview with the Council, when he pointed out to them the illegality of their proposed resolution, told them that I should not agree to it, and indicated the disasters that would happen to the Institute if it were carried, and attempted to be enforced. Then I emphatically told Mr. Eastwood that, with all my solicitude for the preservation of the Institute, I could not agree to the Council's proposal, nor vote for it. During our conversation, there was not a word said about Rule 25; nor was that rule mentioned in a subsequent conversation, which took place after the rule had been passed at the afternoon meeting, when the same party dined together in the evening. In these statements I am confirmed by Mr. Sellers and Mr. Hill, who were present the whole time on both occasions.

It is true that during the afternoon meeting, when Mr. Sellers sat between Mr. Eastwood and myself, I exchanged observations with those gentlemen respecting certain proposed amendments to Rule 25, and some remarks made by the Secretary, and that during the afternoon I voted for several propositions and amendments. But during that time Mr. Eastwood never tried to "induce" me to vote for Rule 25; and, as I have previously stated, I did not vote for it.

I will not argue whether, if I had voted for Rule 25, I should have cancelled the injunction by that act. There will be time enough to argue that when such a contingency arises. But I will say that if a year ago the motion for my expulsion had been carried by the requisite majority, it would have been set aside because of the lying, trickery, and fraud which I set forth in my affidavit filed in the action, and which the accused, who are amongst the men now seeking to promote a new Institute, wisely declined to meet. If they, or those favourable to them, think otherwise, let them try again; and the strange business which Mr. Eastwood proclaims he was engaged in at the recent meeting of the Institute (for my injury and for the advantage of the enemies of the Institute) will be a feature in the proceedings.

In the mixed feelings which Mr. Eastwood's speech inspires, one idea predominates—namely, that whilst I was associating with him in friendly and unrestrained intercourse, with the object of preserving the Institute and defending it from its enemies, his object was, as indicated in his speech, to entrap me, and to get information for the guidance of the Institute's foes.

Although Mr. Eastwood appears to have made many statements to the organizers of the rival Institute, there is one matter which I communicated to him, and which I told him he might make use of, that he seemingly did not mention to the meeting. I gave him the names of three men who have taken an active part in endeavouring to secure my expulsion, who are Past-Presidents of The Gas Institute, and who are engaged in the formation of the rival Institute. These men, I told him, have all been concerned in corrupt trading practices; and the name of a fourth was mentioned, who is also a Past-President, who had written to inform traders that he would no longer accept commissions. Regarding this latter gentleman, I am making further inquiries.

I may also mention that four Past-Presidents have made partnership trading proposals to me, and that one of those proposals was of a fraudulent character.

The members of the Gas Institute and the public will be able to form, from the foregoing, their own estimate of some of the leaders who are endeavouring to form a new Institute, and of their pharisaical cant, when they give as their sole reason for doing so, that the existing Institute is contaminated by an objectionable "trading element."

This letter would have been sent last week, had I been able to see Mr. Sellers, with whom I wished to confer on matters of fact referred to herein before writing.

Leeds, July 11, 1889. GEO. BRAY.

SIR,—Under the above heading, a letter appeared in your contemporary of the 13th inst. from Mr. Geo. Bray, which has caused me much astonishment and pain, and deep regret that a friendship of so many long years should end in such a manner—without even a single note, or drawing my attention to anything which he might have thought incorrect.*

I have read and re-read that letter, to find the reason why it should have been written, but without success; the only clear point seems to be that he thinks I have tried to entrap and injure him. Well, I can clearly say that I never have, and never tried to injure him; as for entrapping him, why, his own letter shows him different—apart from the known difficulty of doing so—and everything I have said and done, to which he refers, has been in every respect without any conference whatever with any of those to whom he has been opposed in The Gas Institute. In the matter of the trading element in the Institute, everyone who has had any opinion from me knows that I have always opposed its presence under any disguise; so much so that I endeavoured to obtain a copy of the "trading element" rule of the proposed new Institute, so that if I thought it suitable I might propose it as an amendment at The Gas Institute meeting. And I may say that, so far as I can remember, no communication has passed between myself and those to whom Mr. Bray has been opposed for nearly two years. Therefore, it is impossible I can have given them information respecting him.

I will now consider some of the points in Mr. Bray's letter; and will first observe that Mr. Bray is in error in saying that I went to him in Great George Street. The fact is that he came up to me in the lobby of the Institution, in his usual friendly manner, and said that I was the very man he wanted to see. He asked me to wait a moment, which I did; then he returned and invited me to lunch with him, and to have a quiet chat. We went to the "Criterion." Well, we did have a chat by our two selves; whilst Mr. Sellers and Mr. Hill went ahead—sometimes a long way ahead, and therefore they are not in a position to say all of what was or was not said. And if Mr. Bray had not taken exception to my remarks on Rule 25, his statement of what was said by me on that occasion would be correct so far as it goes. I also said, in my opinion, to pass such a resolution (extraordinary) without his consent would be a contempt of Court, which would involve the Institute in proceedings which would leave the Institute without one penny in the locker; and I am quite as certain that Rule 25 was discussed. During that walk I told Mr. Bray that, just before leaving the meeting for lunch, I had spoken particularly to one gentleman on the Council, to ask him if they were going to try and pass the new rules. When he assured me that they were, with certain other remarks, I stated that I had certain alterations to propose on Rules 3, 5, and 16; but as they did not change the principle, it would be better if I showed him what they were, so that he would know what they were. I did so, and thought that there would be no difficulty about them. In Rule 3, instead of "and not engaged as principals," read "and not being principals." In Rule 5, which it was not proposed to alter, I wanted to add to the existing rule these words: "Such person not being the agent or representative of any trading or manufacturing firm supplying material to gas-works." In Rule 16, to insert in the third line, after "trustees," the words "who shall be members of the Institute." I mention all these things so that there may be no misunderstanding or mistaking the object I had in view; and I showed them also to Mr. Bray. When we got to our destination for lunch, I certainly gathered the opinion from what Mr. Bray had said, that he would vote for—I think the words used were—"my own degradation." If I have been mistaken, I am very sorry that, in this instance for many years, I was unable to understand what was said.

With regard to Mr. Bray not voting for Rule 25, I may say that I have not the least doubt about it. Over that rule there was much talk. Neither Mr. Bray nor I spoke, I think, except between Mr. Bray, Mr. Sellers, myself, and a gentleman who sat behind Mr. Bray and frequently joined in our conversation. Mr. Bray may perhaps remember his name. Upon one part of Rule 25, Mr. Bray was particularly interested; and Mr. Sellers had many tries to get a word in at the meeting, for the pass-word seemed to be "out of order." Now Mr. Bray and I talked over the point at issue; and as none of them had a copy of the proposed rules, I gave them the use of mine. The alterations I put down (and retain) on my copy, to meet Mr. Bray's views, were at the fourteenth line, as follows:—After "deciding on the question of expulsion," read "after having heard the charges against the party, and his defence." For it had been a sore point with Mr. Bray that he had never been brought before his accusers, &c. Now, I put it to Mr. Bray if he did not, after all, vote for that rule, which was to give him what he had so much wished for, "to come face to face with his enemies; and I ask Mr. Bray if he did not say, after that vote: "It is the first vote that I have given for years, and I have given it freely." I have no doubt that Mr. Bray is mistaken, and the above expression of his may remind him of the circumstance.

I remember very well what was said to me by both Mr. Bray and Mr. Sellers respecting his (Mr. Sellers's) conference with the Council of The Gas Institute, and their opinion of it. But, if I remember correctly, it was at dinner that evening, at Mr. Bray's hotel; and certainly after that time nothing was said respecting any of the rules. The time for action was past, and there was no use in talking; and, moreover, my attention was riveted by some astounding statements which Mr. Bray had made respecting certain gentlemen, and which he requested me to make use of, and I saw by his manner of speaking and looking that he had an absolute confidence in their correctness. But surely Mr. Bray cannot be angry with me because I did not stand at the street corners and proclaim all the defamatory statements he had made over the

* This letter is substantially the same as that which we received from Mr. Bray by Friday morning's post, and which is given above.—ED. J.G.L.

dining-table. If I had done so, I should not have followed the example of my astute friend, who even in his last letter to the paper has not mentioned the names of the parties referred to. No, no, Mr. Bray! I will endeavour to learn from you to be cautious about making statements which may be clear enough to your own mind but difficult to prove to others.

There is only one other point to which I must refer; and it is that which Mr. Bray describes as "the strange business which I am engaged in for his injury, and for the advantage of the enemies of the Institute." I am free to confess that I have no such business on hand, and never pretended to have. I have not, and I have not tried to injure him; very far from it. The only thing to which he can refer is a matter which arose out of his own remarks at dinner that day, in which Mr. Sellers joined; and such was the impression produced upon my mind that, as there was no reservation whatever (but the other way), I conveyed to the gentleman referred to my impression, and he at once said: "I have not the slightest animosity against him, and should be glad to meet him any time he is in London; to meet by our two selves and talk matters over, and see if we could not come to some understanding." I asked him if I might say so. He said: "Yes; but it must be a matter between our two selves." After this I, being unable to go to Leeds, wrote to Mr. Bray a private note, stating the above facts, which clearly show that I had no business on hand but just to tell him that there was no difficulty in the way of his following up the advice given him by Mr. Sellers at the time when Mr. Bray narrated the circumstance which had occurred in the porch of the Institution of Civil Engineers, and explained the impression it had formed upon his mind.

I have written a long letter; but the question is one which does not admit of much brevity. I have endeavoured to be exact; and if I have not used the precise words spoken by the different parties, I have given the substance. If the opinions I have formed of Mr. Bray have been erroneous, I can only say that they were honestly formed, and with the best wishes for Mr. Bray and The Gas Institute.

Linacre, Liverpool, July 13, 1889. C. Eastwood.

GAS WORKMEN AND THEIR HOURS OF LABOUR.

Sir,—Since the Directors of The Gaslight and Coke Company have granted the eight-hour movement to the stokers, I should like to draw their attention to a class of men who, I think, are fully entitled to it, although their work may not be so laborious, but the responsibility and tax upon their energies is far greater, working as they do 84 hours a week, day and night work, and 18 and 22 hours when changing duties. The men I refer to are principally engine-drivers and valvemen. We are not asking this unreasonably, as the eight-hour system has been granted for some years to the Beckton engine-drivers and valvemen, and also to the valvemen at Goswell Road; and all being in the same Company's employ, I do not see why it should not be extended to all.

Bethnal Green, July 8, 1889. John Wilson, Engine-Driver.

THE USE OF STOPCOCKS AND WATER COMPANIES' LIABILITY.

Sir,—In reply to your correspondents "Waste-Water Meter Company, Limited," in the Journal for June 25, I would say that such a communication serves well enough as an advertisement; but there is not the slightest attempt to answer my letter in the previous number. I referred to Portsmouth having expended £7000 on stopcocks; and it has been repeatedly stated that these are not necessary for the carrying out of the automatic waste-water meter system. If not necessary, such a large expenditure in one department requires some other explanation than quoting one instance where they have not yet afforded the means whereby all waste is stopped.

In the Journal for June 5, 1888, Mr. W. De Normanville, the Borough Surveyor of Leamington, is reported to have said, "that for the working of the automatic meter system, each house ought to be furnished with an outside stopcock, and about one-sixth of the houses are so provided." At the same meeting, Mr. Pritchard stated that "he believed the waste-water meter was not suitable in every instance. It was expensive; and he ventured to say that the same results might be obtained at less cost." This was the case in the neighbouring town of Warwick, where, by the use of a few Kennedy's meters, the consumption was reduced to 17 gallons per head per day.

Your correspondents wrongly state that it is *my* objection to stopcocks—"people putting their walking-sticks into the stopcock-boxes, &c." I gave the pages in the Journal where the cases are reported showing it to be the objection of Magistrates, and not mine. I simply mentioned the point, because I thought it a most important one, and worthy of discussion and interchange of opinion, as to the desirability or otherwise of water companies making themselves responsible for repairs and accidents caused by the stopcock and box in the pavement, as decided by the Magistrates.

What I contend is this: The waste of water can be, and is prevented *without* the use of Deacon's or any other meter. Stopcocks there must be; and, as your correspondent says, they are "a great boon to both the water-works proprietors and the inhabitants." The users of the meter system cannot show such good results without the aid of the stopcock, or why did the Portsmouth Company expend £7000 on these articles? Most towns know the quantity of water being pumped. If found excessive, they may proceed as the Deacon Company must proceed when using their very elaborate and expensive automatic system, No leak can be passed over when each stopcock, meter-cock, and hydrant is sounded. If the whole town is too large to comprise one district, then, for a very trifling expense, three or four inferential meters may be borrowed from stock kept for repairs, and placed here and there to divide the town into districts. It must be a badly-conducted water-works where the "proprietors are completely in the dark as to what becomes of their water."

Night Inspector.

A contract for two large duplex gas compressors and boilers for the Kentucky Rock Gas Company has been placed with the Clayton Air Compressor Works, New York. These compressors have a capacity of 2 million cubic feet per day, and are to compress the natural gas at the wells to a pressure of 200 lbs. per square inch, and force it a distance of 32 miles to Louisville, for light and power purposes.

Parliamentary Intelligence.

HOUSE OF LORDS.

Monday, July 8.

COAL DUTIES (LONDON) ABOLITION BILL.

This Bill was considered by the House in Committee, reported without amendment, read the third time, and passed.

Tuesday, July 9.

COAL DUTIES (LONDON) ABOLITION BILL.

This Bill received the Royal Assent by Commission.

Thursday, July 11.

BELGRANO (BUENOS AYRES) GAS COMPANY BILL.

Lord Herschell, in moving the second reading of this Bill, said its object was to authorize an alteration to be made in the Memorandum of Association of the Belgrano Gas Company, which was formed for supplying gas in Buenos Ayres. The Company desired by the Bill to be enabled to supply electric light as well as gas. His noble friend, the Chairman of Committees (the Earl of Morley), thought that, under the circumstances, there were objections to such a Bill, and that he ought not to move it as a matter of form. For his own part, he entirely concurred; and when, after his noble friend's refusal, he was asked to move the second reading of the Bill, he said he could not do so under the circumstances which then existed, for at that period all that appeared was that a large majority of the shareholders were in favour of the proposed alteration. It seemed to him that this was not sufficient to justify a change which might be distasteful to a minority of the shareholders. There were 220 shareholders with 14,000 shares. Inquiries had since been instituted by those in charge of the Bill; and the result showed that 218 shareholders, representing 13,964 shares, had expressed their approval—leaving only two shareholders unaccounted for. One of these had lately died, and the other had been abroad and had only just returned to England, and there had been no opportunity of obtaining his assent. Substantially it might be taken that the whole of the shareholders desired the alteration. The circumstances were somewhat peculiar. In an ordinary case it might be said that it was unnecessary to apply for an amendment of the Memorandum of Association, because the existing Company could be dissolved and a new one formed. But in the present instance the Company had certain concessions from foreign Governments; and he was assured that, if such a course were adopted, difficulties would be likely to arise. Under all the circumstances, it appeared that he might safely and properly ask their lordships to read the Bill a second time, as there would be no danger of its creating a precedent which might prove inconvenient hereafter.

The Earl of Morley wished to say a few words in explanation of the position he had taken up with regard to the Bill. It was true that many Acts had been passed for altering the Memorandums of Association of joint-stock companies; but they were all justified by special circumstances over which the companies had no control. On the other hand, many Bills for the same purpose had been refused. There was great danger in touching the Memorandums of Association of a company, though, no doubt, a special case might be made out. But he did not see that the Belgrano Company had made out any such case. It was not enough to show that, in consequence of the introduction of the electric light, the profits of the Company had been diminished. The noble and learned Lord in his remarks said that the consent of all the shareholders had been obtained. But it would be a novel principle for Parliament to legislate simply upon such consent. There were other parties interested besides the shareholders—there were mortgagees and creditors. Then there was already an electric lighting company established at Belgrano, which might have been started on the ground that the Gas Company had no power to provide electric light. He admitted that the present case was a hard one; but this was scarcely enough to justify the adoption of a measure which might set an inconvenient precedent. He left the question, however, entirely to the judgment of the House.

The Lord Chancellor said no satisfactory reply had been given to the objections of the Chairman of Committees. The case simply was that the Company now wanted to go into a different business; but he had heard nothing that would justify any alteration in the rules hitherto observed.

Lord Herschell said the Chairman of Committees in the House of Commons thought it was a matter which should be allowed; and it was very desirable that there should be a common understanding between both Houses as to the course to be pursued in such cases as these.

The House divided, and the motion was rejected by a majority of 21. The Bill was therefore lost.

Friday, July 12.

PRIVATE BILLS (ALTERATION OF MEMORANDUM OF ASSOCIATION).

Lord Herschell moved for the appointment of a Select Committee to join with a Committee of the House of Commons to consider and report under what circumstances or upon what conditions, if any, Private Bills altering the terms of the Memorandums of Association of companies ought to be allowed to pass.

The motion was agreed to.

The following further progress was made with Bills during the past week:—

Bill read a second time, and committed: Cheltenham Improvement Bill.

Bills Royal Assented: Liverpool Corporation Bill, Plymouth Dock (Devonport) Water Bill, Stapleford and Sandiacre Water Bill, Wakefield Corporation Bill.

HOUSE OF COMMONS.

Wednesday, July 10.

ELECTRIC LIGHTING PROVISIONAL ORDERS BILLS.

On the order for the second reading of the Electric Lighting Provisional Orders (No. 2) Bill,

Sir G. Campbell said he had no desire to stop the progress of the Electric Lighting Bills, but merely wished to be assured that the section of the Act of 1888, which provided that the consent of the local authority should be obtained before a Provisional Order was granted by the Board of Trade for the lighting of any district had not been forgotten. In the case of the Bills now before the House, he complained that they were asked to read them a second time without having had an opportunity of considering the special report of the Board of Trade with regard to those Orders in respect to which the objection of the local authorities had been overridden.

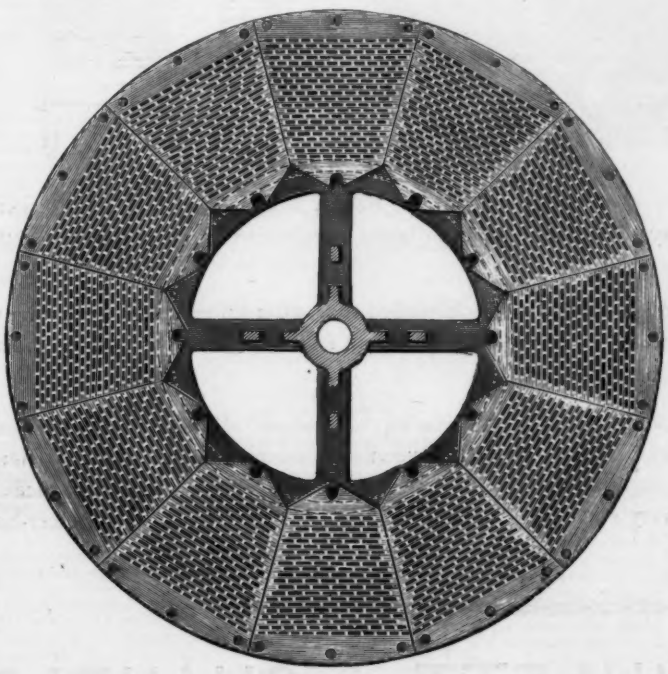
Sir M. Hicks-Beach said the Act of last session was properly stringent upon the point which the honourable member had raised. A special

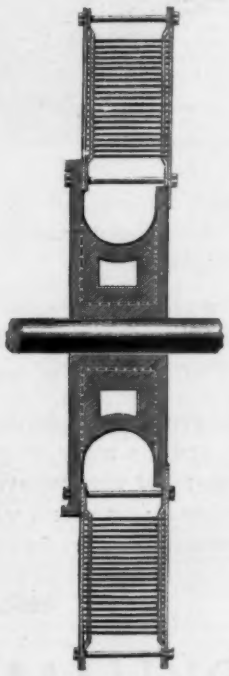
KIRKHAM, HULETT, and CHANDLER'S
NEW PATENT
"STANDARD" WASHER.

KIRKHAM, HULETT, & CHANDLER, LIMITED, have the pleasure of drawing the attention of Gas Engineers and others interested in the question of the extraction of Ammonia and other Impurities from Coal Gas, to their New Patent "Standard" Washer-Scrubber, which has been adopted at the Beckton and Pimlico Stations of The Gaslight and Coke Company, and elsewhere, and found to give every satisfaction.

The original "Standard" Washer-Scrubber (of which 368, equal to a daily capacity of 318,560,000 cubic feet of gas, have been supplied) was admittedly the best machine in the market for the purpose for which it was designed; and the experience gained by the Company during the past nine years has resulted in the production of an improvement on the original patent, which may be briefly described as follows :—

In place of the indented iron sheets made up in segments and technically called "Bundles," the washing surfaces are now constructed of wooden laths, kept in position by being passed through slotted iron sheets, and then butting on to plain sheets, bolted together as shown.



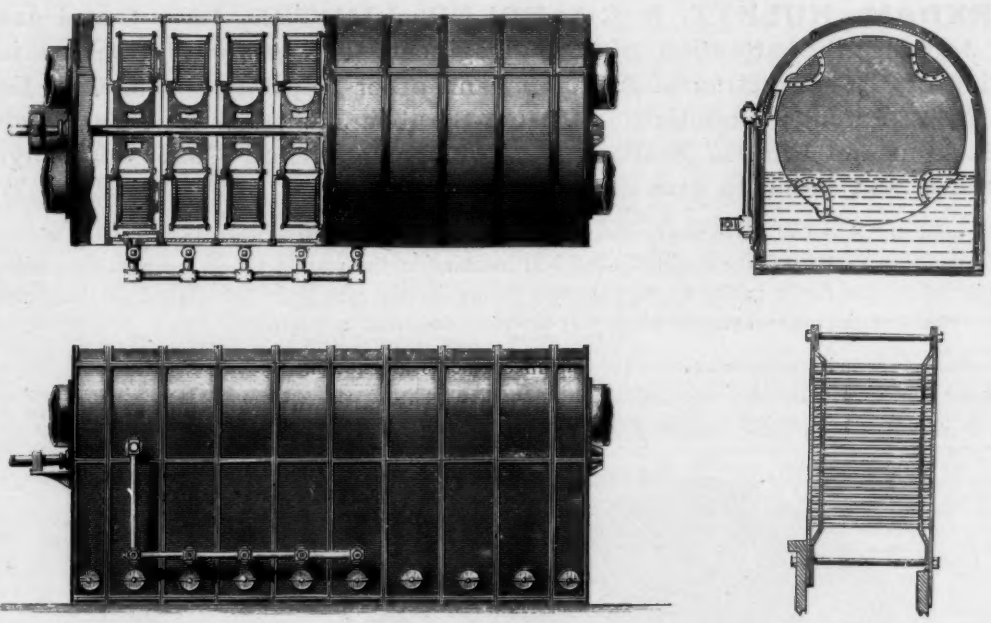


THE ADVANTAGES OF THIS SYSTEM ARE—

(1) The Driving Shaft of the Washer-Scrubber is relieved of 7-8ths of the weight (the weight of the Wooden Bundles being only 1-8th of those in iron).
(2) The Weight in Motion is only 1-8th of that in the original "Standard" Washers.
(3) The Driving Power required is reduced by 7-8ths.
(4) The "Wear and Tear" is reduced 7-8ths.
(5) The Washing Surfaces keep perfectly clean and free from deposit from end to end of machine.

Another invention embodied in the Company's new patent, consists in an arrangement by means of which the liquor is caused to flow *automatically* from the foulest bay back to one or more bays through which it has already passed. Thus the liquor can be automatically worked over and over again, increasing the strength, and in the process removing a large percentage of Sulphuretted Hydrogen and Carbonic Acid from the Gas.

The apparatus used to obtain the above results consists of a number of buckets secured to the side of the washing devices in the foulest bay where the water level is lowest. The buckets revolving with the washing devices on the shaft dip into the liquor, and when carried up, empty into a spout protruding from a vertical pipe running up the outside of the Washer, from whence the liquor naturally runs through a horizontal pipe at foot to any bay desired, as shown, being regulated by the cocks. By referring to the drawings, the apparatus will be understood.



The Company will be glad to send a sample of the new "Bundle," and submit drawings and tenders when desired; and have every confidence that their latest invention will meet with the approbation of Gas Engineers.

As a proof of the value of the invention, it may be added that, after an extended trial, The Gaslight and Coke Company have given a second order for the apparatus for their Beckton Works, and also that several other orders are in course of execution.

The patent wood devices are being supplied to existing "Standard" Washers where renewals are required, and are made in segmental bundles to fit between the wheel plates, similar to the present iron sheets; and Engineers will at once see that the substitution of the improved wooden devices in place of the indented iron sheets will so very materially prolong the life of the "Standard" Washer-Scrubbers as to warrant the outlay for renewal.

KIRKHAM, HULETT, & CHANDLER,
Limited,
— PALACE CHAMBERS, —
BRIDGE ST., WESTMINSTER, S.W.

London: Printed by WALTER KING (at the office of King, Sell, and Railton, Ltd., 12, Gough Square); and published by him at No. 11, Bolt Court, Fleet Street, in the City of London.—Tuesday, July 16, 1889.

report had been duly framed; but it was not ready for presentation to members. He had had to deal with exceptional difficulties. The House was aware that a searching inquiry had been held by Major Marindin into all the proposals for lighting the Metropolis which had been made by electric lighting companies for various districts overlapping one another, and sometimes made without the consent of the local authorities. It was only with the greatest possible difficulty that he had been able to frame Provisional Orders as the result of the inquiry at such a period of the session as the present, when he hoped it would not be too late to pass them into law. He thought it was a great discredit to the country that the Metropolis should not have had the advantage of the electric light. He trusted that, while every proper interest would be safeguarded by the Committee to which the Bills would be referred, it would be found possible during this session to deal with the matter, which might have been dealt with some time ago but for defects in the general law. They had, before granting the Provisional Orders, made a very careful inquiry into the financial capacity of the various companies to carry out the powers with which they would be entrusted; and the Board were satisfied that they were justified in granting the Provisional Orders, with the belief that the powers would be carried into effect. The honourable member had referred to the objections of the local authorities which the Board had felt it to be their duty to overrule as if they had been general. This was not the case. It would appear from the special report that in only two instances in the whole of the Metropolis were objections made on any important grounds. The others were practically settled; and in the two cases which he had mentioned, the objections were not based on matters of principle; but of detail affecting clauses, which could be properly dealt with by the Committee. He trusted he might ask the House to forward this matter by advancing the Bill a stage.

The Bill was then read a second time, as were also three other Electric Lighting Provisional Orders Bills relating to the Metropolis.

THURSDAY, JULY 11.

METROPOLIS WATER (No. 3) BILL.

The Order for the second reading of this Bill on the 17th inst. was read and discharged, and the Bill withdrawn.

LOCAL AUTHORITIES AND THE ELECTRIC LIGHTING SCHEMES FOR THE METROPOLIS.

Sir G. CAMPBELL gave notice that on Monday, July 15, he would ask the President of the Board of Trade whether, in each case in which a Provisional Order for electric lighting has been granted by the Board of Trade, the proposed Order was previously submitted to the local authority of every district in which the Order would have effect, and the consent or refusal of that authority was directly invited, in accordance with the provisions of section 1 of the Electric Lighting Act, 1888; if he has yet satisfied himself as to the County Council for London being, in regard to the Thames Embankment, bridges, and certain main roads, the Local Authority in some parts of the Metropolis; and whether, in addition to a general approval of a model form, the London County Council were invited to consent to any Provisional Order affecting their jurisdiction as Local Authority, and whether they consented; and if so, how it comes that they now oppose the Provisional Order Bills relating to the electric lighting schemes for the Metropolis.

THE FOLKESTONE WATER COMPANY AND THEIR CONSUMERS.

Mr. HOWORTH asked the Secretary of State for the Home Department whether he was aware that in a case recently brought before the Borough Magistrates at Folkestone, involving an important dispute between the consumers and the Water Company, the Magistrates' Clerk (who is also Solicitor to the Company) insisted upon advising the Magistrates, after a protest from the prosecuting Solicitor and an intimation from the Bench that they were willing to sit without a Clerk; whether the Clerk did, as a matter of fact, advise the Magistrates to find in favour of the Company; and whether he would inquire into the conduct of the Clerk.

Mr. MATTHEWS: I am informed by the Justices' Clerk that he is not the Solicitor to the Water Company except in parliamentary proceedings, and that he never advises them in local matters. In this case he was not consulted by the Company, who were represented by a London solicitor. He acted as Clerk in the case, and advised on points of law, with the sanction of the Justices. The proceedings in a suit of this nature must be regulated according to the discretion of the Justices; and this is not a matter in which I can interfere.

FRIDAY, JULY 12.

ELECTRIC LIGHTING BILLS.

The Electric Lighting Provisional Orders Bills (Nos. 2, 3, 4, and 5) and the Metropolitan Electric Supply Bill were referred to a Select Committee, consisting of Sir G. Trevelyan (Chairman), Sir H. Roscoe, Mr. Story Maskelyne, and Mr. Dunscombe; to meet on Tuesday, July 16.

STOKERS IN THE ROYAL ARSENAL GAS-WORKS.

Mr. CUNINGHAME GRAHAM gave notice that on Monday, July 15, he would ask the Secretary of State for War, if he is aware that large numbers of the Arsenal gas stokers are leaving their employment therein, and going to other factories where the hours of labour are only eight per day; and whether he will consider the advisability of making the normal working day in the Arsenal eight hours, in order to avoid losing the services of the picked workmen in this industry.

The following progress was made with Bills during the past week:—

Bills read a second time, and committed: Metropolitan Electric Supply Bill, Newry Improvement Bill.

Bill read the third time, and passed: Eastbourne Water Bill.

Petitions against the Electric Lighting Provisional Orders Bills relating to the Metropolis were presented from the following public bodies and companies: Gaslight and Coke Company, London County Council, London Hydraulic Power Company, Strand District Board of Works, Vestry of St. James's, Westminster, Vestry of St. Margaret's and St. John's, Westminster, Wandsworth District Board.

Petition withdrawn: Rastrick Local Board against Rastrick Water Bill.

Legal Intelligence.

WESTMINSTER COUNTY COURT—WEDNESDAY, JULY 10.

(*Before Mr.* F. BAYLEY, *Judge.*)

WISCH *v.* THE GASLIGHT AND COKE COMPANY.

ALLEGED WRONGFUL DISMISSAL OF A GAS STOKER.

This was an action brought by Reuben August Wisch, a scoop-driver, of 24, Mayfield Road, Plaistow, E., to recover from The Gaslight and Coke Company the sum of £1 18s. 9d. for one week's wages due to him in lieu of notice.

Mr. W. M. THOMPSON appeared for the plaintiff; Mr. BESLEY for the defendants.

Mr. THOMPSON, in opening the case, said it was a test action affecting a large number of gas workmen in the Metropolis. The plaintiff was a scoop-driver in the employment of the Company at their Beckton works. He entered their service in 1884, and remained till July last year, when he left on account of a disagreement with the foreman. In the following November he again entered the Company's service, and worked until the 24th of May of the present year, when he was summarily dismissed. On the 4th of May he went away ill, but returned on the 18th, when he was set to work again. He worked until the following Friday night, and was then discharged; the only reason given being that the Company were getting rid of certain of their hands. The plaintiff had signed a contract with the defendants which made it incumbent upon each of the parties to give a week's notice to terminate the engagement. He then called for the agreement.

Mr. BESLEY said there was no such thing as an agreement, excepting one which was signed in 1884. This he would produce; but it could have no bearing upon anything done in 1888.

Mr. THOMPSON replied that this contract made it compulsory that the plaintiff should join the Company's Provident Society. He then asked for the rules of the Society, which he said showed that Wisch was entitled to a week's notice.

The contract and rules having been put in,

Mr. THOMPSON said that, when his client re-entered the Company's service, he did not sign an agreement. He should, however, show that in other cases a week's notice had been given to men who had not signed contracts. The defendants would contend that the plaintiff was only a casual workman; but he should submit that a man who worked at one place six months straight off could not be so regarded. Besides, plaintiff was paid weekly wages, and was a member of the Provident Society, which casual workmen were not allowed to join. He (Mr. Thompson) maintained that the real reason for his client's dismissal was because he took a prominent part in the gas stokers' agitation.

Plaintiff was then called; and, in answer to Mr. THOMPSON, said he commenced to work for the defendants in 1884, and continued with them as a scoop-driver until July, 1888. He then left; but in the following November he went back and worked in the yard, and afterwards in the retort-house as a scoop-driver. Some of the men known as "casuals" did this work; but no labourer would be put to do it unless he understood it. He was away ill from the 4th till the 18th of May, during which time he received 25s.; being two amounts of 12s. 6d. from the Provident Society. On recovering he started work again, but in the yard, where he remained until the following Friday night, when he was told he must consider himself "finished up." In consequence of this, he went to Mr. Kearns, the carbonizing foreman, who told him that the order was to be carried out, and that his place was filled up. Witness asked that he might have a week's notice; but this Mr. Kearns said was not necessary, as he was not a "signed" man—meaning that he was not under a written contract. He then went to Mr. Beale, the Resident Engineer at the Beckton works, who told him that his (witness's) services were no longer required, and that they wanted to get rid of some more men of his sort. There was going on at that time an agitation amongst the men, in which witness had taken a prominent part. He signed an agreement when he became a member of the Provident Society.

In cross-examination by Mr. BESLEY, witness said he and two other men had to fill 28 mouthpieces, which constituted a day's work. He did not sign an agreement in November, 1888, when he re-entered the Company's service. He worked two or three days in the yard before he was put on as scoop-driver; and then he received his old wages of 5s. 6½d. per day, or 38s. 9d. a week. In the winter he sometimes worked overtime, for which he had extra pay. He did not go to work on Saturday, May 4, and on the next day asked to be away, as he was ill. He was off then till the 18th, during which time he was paid by the Provident Society. He did not know whether or not any men had ever been discharged without notice excepting himself. When he went back in November he did not ask under what conditions he was re-engaged. Mr. Beale told him he was to recommence work. He did not work on the 20th of May, because he was told by one of the foremen that he was not to do so; but he worked on the 21st, and for this he was paid 4s. He worked in the yard the whole of the week up to the Friday when he was dismissed. He was not told on the Friday morning that he was to leave that night. When he was dismissed, something was said about the number of hands being reduced.

Mr. BESLEY: Is this your own individual action, or a test case?

Witness: It is a case to determine that men shall not be discharged at a minute's notice.

How many men does your action represent as a test case?—About 200.

Over what period of time are the discharges spread?—I do not know.

Cross-examination continued: No one had induced him to bring his action; nor had he advised the remaining 199 men to take similar proceedings. Only one other person was discharged at the same time as himself. He did not doubt that the Company were reducing the number of hands when he was dismissed.

Joseph Gandy was next called on behalf of the plaintiff, and stated that he was discharged at a moment's notice. He had not signed a contract when he was dismissed without notice; but when he was employed under a contract, he had had notice.

William Ward gave evidence to the effect that he had worked for the Company on and off for seven years, and was discharged on the 20th of June. On the 12th the foreman gave him a piece of paper which was in fact a week's notice to leave. He had never signed an agreement, and had never been asked to do so. The foreman knew he was an "unsigned" man, because he looked at his book.

John Wray stated that he also was an "unsigned" man, and received notice on the 12th of June to expire on the 20th.

This was the plaintiff's case.

Mr. BESLEY said the action was a really important one to the defendants, in order to teach their workmen that they were wrong and foolish in placing themselves in the hands of agitators. The case was a trumped-up one. The plaintiff was only employed from day to day, and therefore was not illegally discharged. He (the learned Counsel) ought to apologize to his Honour for taking up his time with such a matter as this; and he would only now say that he could not understand how men could be led away by agitators in the way the plaintiff and others had been. He should call witnesses to prove that the plaintiff was only a day worker.

His HONOUR: I do not want your witnesses. I think the case is entirely unfounded. There is no evidence that plaintiff was a weekly servant; on the contrary, he was a daily servant. There must therefore be a verdict for the defendants.

Mr. THOMPSON asked his Honour whether all the men who had not signed contracts were to be considered as daily servants.

Mr. BESLEY remarked that there were about 200 more of these men whom the Judge might have before him on a question of this kind.

His HONOUR: I will deal with the cases when they come before me This man was a daily labourer.

Mr. BESLEY applied for costs, which were granted.

Miscellaneous News.

METROPOLIS GAS SUPPLY.

The Chief Gas Examiner for the Metropolis (Dr. Williamson, F.R.S.) has presented his report on the quality of the gas supplied by The Gaslight and Coke, the Commercial, and the South Metropolitan Companies, during the quarter ending June 30. The following is an abstract:—

I. *With respect to Illuminating Power.*—The average illuminating power, in standard sperm candles, at each of the testing-stations, was as follows:—

The Gaslight and Coke Company—	
Jewry Street, E.C.	16·3
King Street, E.C.	16·8
Dorset Buildings, E.C.	16·7
Ladbroke Grove, W.	16·5
Devon's Road, E.	16·8
Carlyle Square, Chelsea, S.W.	16·4
Camden Street, N.W.	16·2
Graham Road, E.	16·3
Kingsland Road, E.	16·5
Spring Gardens, Charing Cross, S.W.	16·5
Grove Gardens, Regent's Park, N.W.	16·6
Hornsey Road, N.	16·5
Lambeth Road, S.E.	16·4
Millbank Street (cannel gas)	21·3
Commercial Gas Company—	
Parnell Road, E.	16·7
Wellclose Square, E.	16·5
South Metropolitan Gas Company—	
Hill Street, S.E.	16·3
Foster Place, S.W.	16·4
Stoney Lane, S.E.	16·5
Lewisham Road, S.E.	16·4
Burrage Road, S.E.	16·4
Blackfriars Road, S.E.	16·3

It will be seen from these results that the average illuminating power of the gas at all the stations during the quarter was higher than the parliamentary standard. Slight deficiencies were reported during the quarter by the Examiners at the Jewry Street, Camden Street, Graham Road, Grove Gardens, and Hornsey Road stations of The Gaslight and Coke Company, and at the Blackfriars Road and Burrage Road stations of the South Metropolitan Company.

II. *As regards Purity.*—Sulphuretted hydrogen was not present in the gas at any of the stations. The average amount of sulphur in other forms was considerably less than the amount allowed at all the testing-stations, especially at the Devon's Road station of The Gaslight and Coke Company and the Parnell Road station of the Commercial Company, where it amounted to less than half the quantity permitted. With the exception of the City of London stations, ammonia was generally present in the gas more or less frequently throughout the quarter; but only in slight quantities. There was no excess on any occasion.

PROPOSED PURCHASE OF THE BRIERLEY HILL GAS-WORKS BY THE LOCAL BOARD.

At the last Monthly Meeting of the Brierley Hill Local Board—Mr. W. M'Millan presiding—a short discussion took place on a recommendation of the Lighting Committee that the Board should entertain the question of the purchase of the gas-works (if necessary, by compulsion), and to take the necessary steps for carrying out the matter.

Mr. Skidmore said that "compulsion" meant promoting a Bill in Parliament to acquire the works. He referred to figures which he had already produced before the Board in regard to this question, and which were given in the Journal for Jan. 22 last (p. 164). The Board, he thought, should discuss fully the desirability of acquiring the undertaking. It was found, from the manner in which the deputation to the Gas Company were received, that it would be a total impossibility to purchase the works by private treaty (see Journal for March 19 last, p. 541). The point was whether it was desirable to acquire them or not; and if so the Board had no alternative, as the Clerk advised them to go in for compulsory purchase. The recommendation of the Committee was about the only one that they could adopt.

Mr. Fisher considered that before a question of this kind was passed by the Board, it should be thoroughly discussed in Committee. He believed there had been two Committee meetings to consider the matter, at one of which two members were present, and at the other three. He now proposed that the question of obtaining compulsory powers for the purchase of the gas-works be referred to a Committee of the whole Board.

Mr. Rollinson, a member of the Lighting Committee, regarded the question now before the Board as a very serious one. Before they pledged themselves to anything, he thought they ought to have more data to go upon. He was given to understand that an application to Parliament for compulsory powers would cost £1000; and that if they obtained those powers, they would have to pay what an arbitrator put down for the works. Before passing such a recommendation as the one now submitted by the Lighting Committee, pledging the Board to a large expenditure, he considered the matter required more consideration from the members of the Board. He should second Mr. Fisher's resolution.

Mr. Skidmore observed that Mr. Rollinson should not bring forward figures on the one side without showing the advantages on the other side. It was all very well to have it stated in the newspapers that compulsory powers would cost the Board £1000 to start with; but Mr. Rollinson should have added that the purchase of the works would save the ratepayers £2000 a year.

Mr. Rollinson remarked that if he had been at the Committee meeting at which the matter was discussed, he should certainly have objected to this recommendation. He did not think the town was ripe for acquiring the Gas Company's property at present.

Mr. Ferredy said this was one of the most important questions that had ever been before the Board; but he thought, instead of there being a profit of £2000 a year, the Board would be more likely to lose £2000. The cost of the transfer of the works no one could tell; and, to his mind, it would be labour lost to act on the recommendation of the Committee.

Subsequently it was resolved to refer the question to a Committee of the whole Board.

Reduction in Price of Gas at Ringwood.—The Directors of the Ringwood Gas Company announce that, in consequence of the satisfactory increase in the consumption of the gas, they are enabled to reduce the price from 5s. 5d. (to which it was brought about two years ago) to 5s. per 1000 cubic feet, with a discount of 5 per cent. for cash within one month from the close of each quarter; making the net price 4s. 9d. per 1000 cubic feet. In order to still further increase the consumption of gas for cooking, heating, and other purposes, they have resolved to lower the price of gas so used from 4s. 7d. to 4s. 2d. per 1000 cubic feet, with 5 per cent. discount for cash as above-mentioned; thus reducing the net price to 3s. 11½ per 1000 cubic feet.

WIDNES LOCAL BOARD GAS AND WATER SUPPLY.

At the Monthly Meeting of the Widnes Local Board last Tuesday, the profit and loss accounts of the Gas and Water Departments for the year ending March last were submitted with the minutes of the Gas Committee. It appeared therefrom that on the working of the gas undertaking there had been a loss of £278; and in respect to the water-works, a profit of £127. In moving the confirmation of the minutes, Mr. H. Gaskell stated that the Committee had made an alteration in their proposals for obtaining a supply of coal for gas making. In past years they simply had one contract for coal and one for cannel; but now they recommended that the contract should be divided among a number of firms. The reason for this alteration was that during the present year there had been an advance of something like 50 per cent. in the price of the coal which they had been in the habit of using. This increase would have necessitated an advance in the price of gas of 3d. or 4d. per 1000 cubic feet, had it not been for the fact that the adoption of the Dinsmore process of gas making had enabled them to abandon the use of cannel, which they had been using during the past few years. By this process, as he had told the Board before, they could obtain equally good results with an inferior quality of coal. Roughly speaking, the advance in the price of coal meant to them something like £2000 per annum; and this, in round figures, was the value of the Dinsmore process to them during the present year. They would see from the minutes that the Committee also submitted their profit and loss account for the year. The loss which there appeared to have been on the gas undertaking did not exist. It was simply a question of book-keeping, as during the year there had been a total reduction in the price of gas of £1549, and of water of £2969. Taken altogether, they had done better this year than any year in their existence. Dr. O'Keeffe thought the Gas and Water Committee, and especially its Chairman, should be congratulated on bringing in a profit to the Board. The Chairman observed that they were the cheapest manufacturers of gas in the kingdom, and consequently in the world, by the use of the Dinsmore process. The minutes were approved.

DUMFRIES GAS COMMISSION.

Annual Statement—Reduction of Price.

At the Annual Meeting of the Dumfries Gas Commission yesterday week—Provost Scott presiding—the Treasurer (Mr. M'Gowan) presented the accounts for the past financial year. In the revenue account there was shown a profit of £2419; and after meeting permanent charges there remained a net profit of £252. Carrying forward this sum, the Manager Mr. G. Malam) in his estimate for the current year calculated that at Whitsunday next the accounts would show a surplus of £920. It was also stated in his report that the cost of the tramway which had been laid down to connect the Glasgow and South-Western Railway system with the gas-works was £1033, of which a balance of £633 remained to be paid; and as the whole of the last loan of £4000 had been expended on the capital account, a new loan might have to be effected for the purpose of paying off this balance, and to meet the cost of a new and improved retort-bench, which he recommended should be erected at a probable cost of £1000, part of which would be chargeable against capital account. The actual indebtedness of the Commission was £25,238; and the reserve fund amounted to £407—being the same amount as that at the end of the preceding financial year, with the addition of a small sum for interest. The quantity of coals (cannel and shale) carbonized during the year was 5015 tons, at an average cost of 15s. 11·23d. per ton, compared with 5134 tons, at an average cost of 14s. 11·15d. in the preceding year. The quantity of gas made during the year was 52,606,000 cubic feet, or an average of 10,489 feet per ton of coal, as against 51,442,700 feet, or an average of 10,020 feet per ton; showing an increase of nearly 500 feet per ton of coal carbonized over the yield in the preceding year. Including the gas used at the works, the quantity sold and accounted for was 46,465,825 cubic feet, being an average of 9264 feet per ton; while in the year 1887-8, the amount sold and used in the works was 44,531,100 cubic feet, at an average of 8763 feet. The unaccounted-for gas was put down at 11·67 per cent. The statement of accounts was approved of; and a general approval of the Manager's report was agreed to—the Gas Committee resolving to delay for a month consideration of the proposal to construct a new retort-bench. The Provost next proposed that the price of gas be reduced 3d. per 1000 cubic feet—making the charge 3s. 6d. per 1000 feet Dr. Cunningham seconded the motion, which, after some discussion, was carried. On the recommendation of the Committee, it was resolved to increase the Engineer's salary by £25; making it £250 per annum.

THE ELECTRIC LIGHTING SCHEMES FOR THE METROPOLIS.

The Board of Trade have issued Memorandums stating the nature of the proposals contained in the Provisional Orders included in the Electric Lighting Orders Confirmation Bills, which, as will be seen by our "Parliamentary Intelligence," were read a second time in the House of Commons last Wednesday. The Orders comprised in these Bills are those applied for by the London Electric Supply Corporation, Limited; the Westminster Electric Supply Corporation, Limited; the House-to-House Electric Light Supply Company, Limited; the Kensington and Knightsbridge Electric Lighting Company, Limited; the Notting Hill Electric Lighting Company, Limited; the Chelsea Electricity Supply Company, Limited; the Electricity Supply Corporation, Limited; and the Metropolitan Electric Supply Company, Limited. The first-named Order authorizes the London Electric Supply Corporation to supply electrical energy within the parishes of Chelsea (except one portion); St. George, Hanover Square; St. James, Westminster; St. James and St. John, Clerkenwell; part of St. Martin-in-the-Fields; St. Margaret and St. John, Westminster; that part of Lambeth north of Westminster Bridge Road; St. Mary, Newington; Rotherhithe; Bermondsey; also in the St. Saviour's, St. Olives, and Greenwich districts. The Westminster Order authorizes the Corporation to supply electrical energy within the parish of St. George, Hanover Square, and the portion of the united parishes of St. Margaret and St. John the Evangelist, Westminster, lying south of the line of the Metropolitan District Railway. The House-to-House Electric Light Supply Order is to sanction the supply of electrical energy within two districts in the parish of St. Mary Abbotts, Kensington. The Kensington and Knightsbridge Order covers portions of the parishes of St. Mary Abbotts, Kensington, and St. Margaret, Westminster; certain parts of the former parish being also allotted to the Notting Hill Company, and to the Chelsea Company. The parish of St. Martin-in-the-Fields is given to the Electrical Supply Corporation; while the Metropolitan Electric Supply Company have three Orders embracing Mid-London (the districts of St. Giles, Holborn, and the Strand), South London (Lambeth, Streatham, and Clapham), and West London (Marylebone). The Orders contain provisions for the laying of mains in certain specified streets within two years from the commencement of the Order; for the deposit (except in the case of the Kensington Company) of £1000 as a guarantee for the completion of the works; for the approval by the Board of Trade of the system upon which energy is to be supplied, and the issue by them of regulations for securing the safety of the public

and ensuring a proper and sufficient supply of energy; for the execution of the necessary works, the breaking-up of streets, &c., and the alteration of pipes, &c., under streets; for the appointment, remuneration, and duties of electric inspectors, and the testing of electric lines and other works; for regulating the manner in which energy is to be charged for, and fixing the maximum price to be charged; for the supply, use, certifying, inspection, &c., of meters; for the revocation of the Orders under certain circumstances; for securing that the undertakers shall not, without the previous consent of the Board of Trade, purchase or acquire the undertaking of, or associate themselves with any other company or person supplying or intending to supply energy within the administrative County of London; for prohibiting the supply of energy by the undertakers beyond the area of supply, and for the removal, within a specified time, of electric lines or works which have been erected or laid down for this purpose; for prohibiting the use of overhead wires without the consent of the County Council, and for the removal, within a period of two years of such wires (if any) already erected by the undertakers within the area of supply; and for enabling the County Council to require the undertakers to place their mains, &c., in subways, where such exist. In the Order of the London Electric Supply Corporation, clauses are also inserted requiring the undertakers to provide such a number of generating stations as the Board of Trade may prescribe, and exempting the stations, in certain instances, from the operation of the Metropolitan Building Act, 1855.

NOTES ON ELECTRIC LIGHTING.

At the Annual Congress of the Association of Municipal and Sanitary Engineers recently held at Portsmouth, Mr. E. J. Silcock, Assoc. M. Inst. C.E., the Borough Engineer of Kings Lynn, read a paper which dealt generally with electric lighting matters.

In his opening remarks, the author said that, as electric lighting might now be said to have passed the experimental stage and reached the practical, and recent legislation, by extending the time before local authorities could compulsorily buy up the undertakings of private companies, had removed the only bar which for the last year or two had prevented capitalists from entering the field, the indifference which had hitherto prevailed with reference to the question ought not to be allowed to continue. They might expect in the very near future that central lighting stations would be established in most of our large principal towns, as they were now being established in the Metropolis and other places. Their clients were in most cases interested either as a body or as private individuals in gas-works; and therefore it was probable that in many towns corporations would not themselves run electric lighting stations. This, however, would not prevent private companies being started, as the Board of Trade had power to grant Provisional Orders to companies where corporations refuse or neglect to undertake the work. These private companies would come into their midst, break up the streets, interfere with extensions of their sewers, drains, gas-pipes, and water-mains, and generally ride roughshod over public and private right, unless they were duly restricted when obtaining their parliamentary powers. To whom, then, must their corporations look to advise them in obtaining these proper restrictions? There was no official connected with their municipal governments, except the borough engineer, who was at all competent to cope with this question; and undoubtedly it was the duty of every one of them to make themselves masters of the subject, so that, when the time came, they would be able to advise their respective clients in this matter as they would do in any other engineering undertaking.

After some remarks on the broad lines on which an installation is designed, and the sizes of the engines and dynamos to produce the required power, the author said that high-speed engines coupled direct to the dynamo offered great advantages. They took up little room, and avoided all losses of transmission by belting or other methods of gearing. Steam-engines were always to be preferred to any other form of motor in large installations, unless water power was available; but good work could be done by gas-engines. The important point about the engine, of whatever type it might be, was that it should be well governed. Electric lighting could never be successfully accomplished unless the engine ran at a perfectly uniform rate at all loads. Having described the several classes of dynamos, Mr. Silcock said it was to the credit of electrical engineers that machines could be purchased giving an efficiency of 93 and 94 per cent.—that was to say, for every 100-horse power transmitted to the dynamo from the engine, 93 or 94 were returned in the shape of electrical energy for utilization outside the machine.

The rapid improvement in electrical machinery having been touched upon by Mr. Silcock, he offered some suggestions as to the wiring of an installation, which, he said, was somewhat analogous to designing a system of water-mains for a town's supply. In testing for insulation, two facts should be borne in mind—(1) That a high mutual insulation was no criterion of the durability of the material; and (2) that the insulation of the cables, and of the installation as a whole were two very different quantities. It was therefore very advisable to specify that the contractor should stand by the insulation for as long as possible. Eminent electricians said five years was not too long. In regard to lamps, the author said that incandescent lights had been tried for street and outdoor lighting, and proved an utter failure; and for such purposes the arc lamp was found more suitable. In street lighting a 2000-candle power arc lamp would illuminate a radius of 80 yards when situated in the centre of the street; but only two-thirds of that distance when placed against the buildings.

The central lighting of towns, he proceeded to remark, could be effected in one of three ways—(1) By direct supply; (2) by the transformer system; and (3) by the accumulator system. The relative merits of these systems were not finally settled; but it might be said that the direct supply system was practically limited to small towns, or to the more densely populated parts of large towns. For the supply of large towns from one station, or for sparsely populated districts, either the transformer or accumulator system must be adopted. After referring to the arguments for and against these latter systems, he said that Major Cardew had pointed out two defects in the transformer system—viz., that alternating dynamos could not be run in parallel, and that no successful alternating motor was likely to be brought out. He (Mr. Silcock) thought these difficulties had now been overcome. Alluding to the distribution of electricity, he expressed the opinion that the cables would generally be laid in cast-iron pipes. In the installation at Bradford, the cables were simply laid in the ground and covered with boards. Where cables were laid in conduits, they should be insulated with vulcanized rubber, as condensation was certain to take place inside the conduit; and if the wires were not insulated, leakage would take place. But lead covered cables were unnecessary where conduits were provided. They were adopted in some installations without conduits; and in such cases they should be sheathed in iron to prevent mechanical injury. It should be taken as a principle that meters should be employed for measuring the current used by each house, and not an annual charge made per lamp.

Respecting that all-important question of cost, he said that the expense of installations of electric light varied very much. An installation of about 2000 16-candle power incandescent lamps, supplied direct from dynamos driven by steam-engines designed and erected by Mr. T. Hewson, the Borough Engineer of Leeds, cost in round numbers 50s. per lamp, including boilers, iron chimney, engines, dynamos, cables, lamps, and fixing. Central stations varied even more than home installations, but an installation of 37,500 lamps, 10-candle power, for Leeds, including site, buildings, chimney, engines, dynamos, cables, transformers, and meters, would cost about 30s. per lamp—the plant to be capable of supplying two-thirds of the total number of lamps at one time with the necessary surplus power. This would leave the consumers to supply their own wiring, lamps, and fittings, as in the case of gas; and this would probably cost £1 per lamp, unless very expensive fittings were used. The cost of working at Leeds, according to Mr. Hewson, came out at ¾d. per 16-candle power lamp per hour; and probably a 10-candle power lamp could be supplied from a central station at the rate of ¾d. per hour, without profit, but including interest and depreciation. In the Metropolitan area, it was proposed to charge on a sliding scale at a maximum price of 8d. per Board of Trade unit (1000 watt-hours). This would probably mean that the consumer of large quantities would be charged about 6d. per unit, which was equivalent to gas at 3s. 9d. per 1000 cubic feet. To this must be added the renewals of lamps, which, taking 1000 hours as the average life, made the cost of electric lighting equivalent to gas at 4s. 6d. per 1000 cubic feet to the consumer. Three years since electricity cost the consumer more than an equivalent of gas at 7s. per 1000 cubic feet. The reduction in the price of gas from its introduction was not by any means so rapid as that of electric lighting had thus been; and apart from the certainty of further development in the art of electric lighting, the lapse of patents alone (of which so many now fetter the work) would, in a few years, reduce the price far lower than it was to-day. The cost of running 2000-candle power arc lamps might, perhaps, be put down at 2½d. per lamp per hour, to cover all charges, but not to make a profit.

Leaving the scientific aspects of the question, Mr. Silcock commended to the Association the following conclusions:—That by reason of a corporation being able to borrow money at a cheaper rate than would be deemed a satisfactory profit to a company, and that it need not make a profit, it can supply electric light to the ratepayers far cheaper than a paying company would. That any future discovery in electric lighting which would produce it more cheaply would, for long periods, benefit the shareholders of a company only; revisions in the price being at intervals of perhaps ten years. That the principle of keeping entire possession of the streets is one which the experience of all towns in regard to tramways, gas, and water companies has taught them should never be yielded. That although a local authority may agree with a company to light a town for a shorter time than the 42 years named in the Act, a company would only agree to this on receiving advantages equivalent to them to the reduction of time.

THE LONDON COUNTY COUNCIL AND THE WATER COMPANIES' UNDERTAKINGS.

The Purchase Bill.

In "Parliamentary Intelligence" in the Journal last week, we recorded the introduction by Mr. O. V. Morgan of a Bill to enable the London County Council to "purchase the rights of existing Water Companies." The Bill, which consists of only nine clauses and two schedules, was issued last Tuesday; and its second reading is fixed for to-morrow. If passed, the Bill will bear the title of the London Water-Works Purchase Act, 1889. It will give power to any of the Companies mentioned in the first schedule—viz., the New River, Chelsea, East London, Grand Junction, Kent, Lambeth, Southwark and Vauxhall, and West Middlesex Companies—to sell to the London County Council a part or the whole of their undertakings. The purchase is to be carried into effect by a deed of conveyance in the form given in the second schedule to the Bill or to the like effect, with such variations and additions as may be necessary. On the execution of this deed, the part of any undertaking, or any undertaking of any Company named therein, is to be transferred to and vested in the Council; and thenceforth the Council are to have and hold the same, and exercise and enjoy all the rights, powers, authorities, and privileges of such Company, and be subject to all the duties, obligations, and liabilities under their Special Act, in like manner in every respect as if they were the Company, but freed from all the provisions of the Special Act regulating the constitution, management, capital, and profits, and subject to the provisions of this Act. Provision is made that all officers and servants attached to the undertaking of any Company at the time of the transfer are to become officers and servants of the Council, and are to hold their offices or situations by the same tenure and upon the same terms and conditions as if the Act had not been passed. The Council are to have power to raise money for the purposes of the Act. Clause 5 specifies that they "may create additional stock in like manner, with the like sanction, and upon the like security as they may create stock under the Metropolitan Board of Works (Loans) Acts, 1869 to 1875; and all the provisions of the said Acts (except the provision as to the limitation of the amount) shall apply to such stock, and to the payment of the dividends thereon, and to the providing out of the consolidated loans fund for such payment, and to the making good any deficiency therein from the Metropolitan consolidated rate, in like manner as if such stock were created under the authority of the said Acts in order to raise money for the purposes of the Acts mentioned in the first schedule of the Metropolitan Board of Works (Loans) Act, 1869: Provided that, in addition to any security upon which such stock may be created under the said Acts and this Act, the same shall, by way of further security, be charged indifferently upon all the undertakings purchased by the Council, and vested in them under this Act, and shall be a first charge thereon." All loans that are raised under the provisions of the Act are to be applied solely to the purposes authorized by the Act; and all moneys received by the Council with respect to the supply of water by them under the authority of the Act are in every year to be applied as follows:—First, in payment of the expenses of conducting, managing, and maintaining the water-works acquired by them, and of supplying water under the authority of the Act; secondly, in carrying to the consolidated loans fund under the Metropolitan Board of Works (Loans) Acts, 1869 to 1871, and the Purchase Act, such sum as the Commissioners of the Treasury may from time to time approve as being in their opinion necessary in order to pay the dividends on, and to redeem all the stock in 60 years from the date of the creation thereof; thirdly, in reducing the charge to the consumers of water, or, on the vote of the Council in any year, in reducing the Metropolitan consolidated rate. The Council are to keep separate accounts of all their receipts, credits, payments, and liabilities under the Act; and they may defray any expenses incurred by them in the execution of the Act as if such expenses were incurred by them in carrying into execution the Local Government Act, 1888.

At the Meeting of the County Council last Tuesday, the Parliamentary Committee reported that their attention had been directed to the Bill

which the Council decided to introduce a short time back for the acquisition of powers to make application to Parliament in relation to the water supply. They said the Bill was threatened with determined opposition, which they understood would be continued at every stage; and, as it appeared from a recent interview which the Chairman, Vice-Chairman, and Deputy-Chairman had with the President of the Local Government Board, that the Council could not expect any assistance from the Government in the matter, the Committee felt that there was no possibility of the Bill being passed this session. Under these circumstances, they recommended that the Bill should not be further proceeded with. This was agreed to without discussion.

EXTENSION OF THE KENT WATER COMPANY'S DISTRICT.

Completion of the Knockholt Reservoir.

Our correspondent for the Sevenoaks district sends us the following:—The recent opening of the new reservoir at Knockholt brings to a climax an important progression in the history of the Kent Water Company. The reservoir, which has been for some time in course of construction, is situated close to the far-famed Knockholt Beeches; and it is claimed to be the highest of any owned by the Metropolitan Water Companies—its altitude being close upon 800 feet above the level of the sea. As from time to time shown in the Journal, the necessity for an efficient water supply for the Bromley and Sevenoaks districts has been long and severely felt; there being times when the fluid has only been procurable at the costly rate of 6d. per small bucketful. Steps to remedy this deplorable state of things were taken by the residents in the district; and the Kent Water Company, having given a satisfactory supply to the town of Bromley, were petitioned by the Rural Sanitary Authority to extend their area to certain other parishes in the Union. This the Company did; and in 1885 they were again petitioned to supply the remaining parishes in the Bromley Union and the adjoining parishes in the Sevenoaks Union. To this proposal the Company assented; but the Sevenoaks Rural Sanitary Authority opposed the carrying out of the scheme, because it did not include one or two small outlying parishes, lying very high, in accordance with a one-sided agreement by which the Company were not to receive any guarantee, but were to pay their profits to the Rural Sanitary Authority. The Company, however, applied for a Provisional Order, which they obtained in 1888; and by Midsummer of the present year, the reservoir, which was designed by the Company's Engineer (Mr. William Morris, M. Inst. C.E.), and constructed by Messrs. John Aird and Sons, had been completed. About 12 miles of pipes have been put down; and the water is now available for anyone in the district who may be desirous of becoming a consumer. The new reservoir has a storeage capacity of 500,000 gallons. It is connected by a pumping-main with the Company's works at Orpington, at which place a Worthington engine has been put up. From this place a good head of water can be constantly maintained; and though the Company have incurred considerable expense in making their extensions to Knockholt, and though, in the words of one of the largest landowners in the Sevenoaks division—Earl Stanhope, who has recently been elected a Director of the Company—there is no intention of going with cap in hand to the Sevenoaks Rural Sanitary Authority, it is obvious that, with the additional facilities and the bountiful supply of water, the further development of the Company's district cannot be long delayed, especially when it is remembered that the Metropolitan Board of Works, who joined issue with Sevenoaks Authority in opposing the Kent Water Company's scheme, has disappeared under the pruning knife of reform. The long connection of the Company with the county, its protracted and persevering struggles in the past, and its series of successes in the present, has elevated it to a position which will ever associate its name with the history of Kent. The Company was incorporated in 1809. Commencing by serving the towns of Deptford, Greenwich, and Woolwich, its area and supply have been enlarged from time to time until it now covers about 170 square miles. In its early days the Company were by no means prosperous. For the first 50 years the average dividend was not 1½ per cent.; but with the growth of the Metropolitan and Suburban districts came the dawn of better days. Under modern management, which has never lost sight of the fact that a company should be conducted in the public interests, the dividends have approached the limit allowed by Act of Parliament. With the higher dividends, and the increasing funds, the Directors have been able to apply the surplus profits to the reduction of the water-rate; and this they have done without any pressure being brought to bear upon them.

THE PORTSMOUTH WATER-WORKS.

In the Journal last week reference was made to the recent visit of the Association of Municipal and Sanitary Engineers and Surveyors to the works of the Portsmouth Water Company. Advantage was also taken of the occasion by the Company to celebrate the opening of a new pumping-station; the engines being started after luncheon by the Chairman, Lieut.-Col. Galt. The water supply of Portsmouth is not only one of the most abundant and constant in the country, but it has the further merit of being of excellent quality, and drawn from springs contiguous to the borough. The works, which are now duplicated as a provision against accidents, and to meet the wants of an increasing population, are situated at Havant; and the supply of water is at high pressure with constant service. The water is obtained from natural springs, which rise to the surface and overflow, when not interrupted, to the sea. The area from which the springs are fed must, according to the opinion of Sir R. Rawlinson, exceed 100 square miles in extent; the water falling on the surface in the form of snow, rain, and dew, and filtering through clean porous strata to a depth of several hundred feet, forming a vast subterranean reservoir under the chalk, from which, by deep underground channels, the springs are supplied. The supply is pumped from the Havant and Redhampton stations into reservoirs constructed on the southern slope of Portsdown Hill, about 150 feet above Ordnance datum, and having an aggregate storeage capacity of 9¼ million gallons, whence the water flows by gravitation to the consumers. The present population of Portsmouth is about 145,000, and that of the other districts about 5000; so that the total population furnished is, roughly stated, 150,000. The quantity of water pumped daily averages between 5 and 6 million gallons, which, excluding the quantity used in the Dockyard and the public establishments, amounts to about 18 gallons per head. The number of premises supplied is 32,385, and the minimum yield of the springs is stated to be 15 million gallons per day. The surplus beyond the requirements of the Company is temporarily used for mill purposes; so that a large reserve of water remains for future needs.

St. Austell Water Supply.—The St Austell Local Board contemplate the erection of water-works, and an inquiry has lately been held by Mr. S. J. Smith, C.E., one of the Inspectors of the Local Government Board, regarding their application to borrow £2000 for the purpose. After the inquiry the Inspector surveyed the site of the proposed supply and reservoir.

SHEFFIELD CORPORATION WATER SUPPLY.

The Payment of Interest on Unproductive Capital.

At a Meeting of the Water-Works Committee of the Sheffield Corporation last Wednesday week, the Town Clerk (Mr. Pye-Smith) reported that he applied, on Feb. 26 last, to the Local Government Board for their sanction to the borrowing by the Corporation of £12,216 for the purposes of the water undertaking. The Assistant Secretary to the Local Government Board (Mr. A. D. Adrian) replied, on May 2, as follows:—"The Board do not consider that the payment of interest upon unproductive capital is a purpose for which money may be borrowed under the Local Act; and they have therefore reduced the amount of the loan authorized from £12,216—the sum to which the application relates—to £8072, by the omission of the sums £1444 expended last year, and £2700 estimated (as they understand) to be required during the present year, for payment of such interest. The formal document conveying their consent to the borrowing of £8072 accompanies this letter." Two days afterwards, the Town Clerk sent the following answer to this communication:—"I am instructed to call your attention to the fact that interest has been charged to capital under the sanction of the judgment of the Court of Chancery (Vice-Chancellor Malins), obtained on two different occasions by the late Sheffield Water-Works Company—the first occasion being in the case of *Bardwell and Others v. Sheffield Water-Works Company and Others*, decided in 1872 (reported in 41 L. J. R., Chancery, N. S., p. 700), and again in 1878 in the case of *Waterfall and Others v. Sheffield Water-Works Company and Others*, which I think is not reported in the Law Reports, but of the judgment in which I send you a copy herewith. You will find from the latter portion of that judgment, as well as in the previous case, that the Court clearly sanctioned the payment out of capital of interest upon unproductive capital. The second case refers to that portion of the water-works undertaking in the Ewden Valley which is still undeveloped. The Corporation of Sheffield consider that as they purchased the undertaking of the Water Company with all its rights, they purchased the benefit of that judgment, and that therefore it is a perfectly legitimate thing to charge the interest on capital in the way mentioned. Under these circumstances, I am directed to ask the Board to reconsider their decision with regard to the deduction of the two sums in question; and for this purpose I return herewith the sanction which you were good enough to forward to me, in the hope that the Board will feel justified in amending it." The Local Government Board, in acknowledging the receipt of this letter, stated that they had considered the representations contained therein, as well as the judgments of the Courts upon which the Corporation relied in support of their contention; and they saw no sufficient reason for reviewing the decision which they communicated in their letter of May 2, and returned the sanction which accompanied the letter. The correspondence was laid before the Committee on the 5th ult., when they appointed the Mayor (Alderman W. J. Clegg), the Chairman (Alderman Gainsford), the Town Clerk, and the Engineer (Mr. E. M. Eaton) as a deputation to the Local Government Board for the purpose of further explaining the question, and endeavouring to get their permission to the borrowing of the £4144, which they had refused to sanction. The President of the Local Government Board having agreed to receive the deputation, the latter (accompanied by the Right Hon. A. J. Mundella, M.P., and Mr. Howard Vincent, M.P.) met him on the 24th of June, and laid the whole case before him; and he promised to consider the question and send his reply. On the 3rd inst. the Local Government Board forwarded the following letter, announcing their final decision:—"I am directed by the President of the Local Government Board to state that he has carefully considered the representations made by the deputation from the Town Council of Sheffield, which attended at this office on the 24th ult., and has again referred to the Board's legal adviser the question as to the power of the Board to authorize the Corporation to borrow under their Local Act of 1887 for the payment of interest on unproductive capital, and that he has advised that the Board have no power to sanction the borrowing of money for this purpose." It does not appear from the published reports of the Committee's meeting that they took any further steps in the matter.

THE VYRNWY EMBANKMENT.

A Reassuring Statement.

At the Meeting of the Liverpool City Council on Wednesday, July 3—the Mayor (Mr. E. H. Cookson) presiding—a statement was made by the Chairman of the Water-Works Committee concerning the safety of the Vyrnwy dam.

The Town Clerk (Mr. G. J. Atkinson) read the following letter, dated the 2nd inst., which had been received from the Chairman of the Salop County Council (Mr. Alfred Solway):—"Sir,—Several communications have been addressed to me on this subject; and I now see a rumour in the paper that it is the intention of the Liverpool Corporation to have an official inquiry by competent engineers into the whole question of the construction and stability of this [the Vyrnwy] dam. May I ask whether there is any truth in this rumour; and if so whether you will allow public bodies who are interested in the safety of these water-works to be represented at the inquiry."

Alderman Bower, the Chairman of the Water Committee, said perhaps he had better first refer to several statements that had been made in the newspapers with regard to the masonry dam at Vyrnwy. Naturally—bearing in mind the importance of the subject and the disaster at Johnstown—in the minds of those who were not acquainted with the matter and not able practically to judge for themselves, those statements might give rise to more or less anxiety, unless they were contradicted. In the first place, he wished to broadly state to all who were interested in the Severn Valley that there was not the slightest shadow of foundation for any one of the rumours that had been circulated. If the Water Committee were capable themselves of judging this matter, and were deserving of the confidence of the public in the way in which he was happy to say confidence had been bestowed upon them in the past, it was his duty to most emphatically give a broad and distinct contradiction to any rumours respecting an affair of this kind. One statement he had heard was that the dam had deflected an inch. Even if it had deflected an inch, there would have been nothing in that. The dam was 1173 feet long; and they had it in Sir Andrew Clarke's report that a dam which he was interested in in India, and which was only 500 feet in length, had deflected ¼ inch. But what were the facts of the case? They had two of the finest instruments, one placed at each end of the embankment, for testing purposes. One was the 30-inch transit instrument, which was planted there especially to test the deflection that took place in the dam. Not satisfied with that instrument only, they had a fine steel wire pendulum 70 feet in length, with a heavy weight suspended at the end of it, which showed, to a very infinitesimal portion of an inch, any deflection or bending of the embankment. What were the results? The transit instruments gave them a total deflection of only one-tenth of an inch. Then, with the other instrument, which was perhaps more sensitive, the result was 0·1032 of an inch—which was about the tenth of an inch—as a maximum. He must say that

individually he was much surprised at the very small deflection, which was far less than could have been anticipated. Another thing, he might say that the amount of moisture on the lower face of the wall was insignificant. He had expected from the results at other dams that he had inspected that there would be a considerable amount of moisture; there was, however, practically none. Another question had been raised about a departure from Mr. Hawksley's plans; and it was said the bank was not a stone embankment right across. It was absolutely a stone embankment right across from one side to the other. Moreover, the stone embankment was carried into the side of the mountain, and was as it were knitted into the solid rock. But what had given rise to the talk about clay puddle? Mr. Hawksley when the stone embankment was decided upon in the way in which it had been constructed, thought as a matter of precaution he would lay clay puddle along the face of it at the foot; while Mr. Deacon, as an additional matter of precaution, had continued that clay puddle into the heart of the mountain. He did this because, although the hill into which it entered was glacial clay, it was not quite as homogeneous as the clay puddle trench would be when carried into it. It was unfair to say that the embankment was not a solid stone embankment right along the valley as far as the water bore upon it. With regard to the assertion as to variation in strength of the dam, he said emphatically that Mr. Hawksley, and Mr. Hawksley alone, settled what the strength of the embankment should be; and it had been kept to that strength. He stated emphatically that the embankment was perfectly safe. To begin to cavil at one point or another where there might be a desire to throw dust in the eyes of the public was creating a scare where none need be created.

Dr. COMMINS asked whether the deflection was down the valley in the direction of the current of water; whether it was a permanent one; or, as he understood it, something which caused a temporary oscillation?

Alderman BOWER said whether it was owing to the change in the atmosphere, he did not know; but the transit instruments had shown a hairbreadth deflection the other way. He moved that the Town Clerk reply to Mr. Solway stating that the Council considered there was no necessity for enquiring into the matter to which he referred.

Mr. J. B. SMITH seconded the motion, which was agreed to.

The members and officials of the Shrewsbury Corporation recently paid a visit to the Vyrnwy dam and lake, and were accompanied on their tour of inspection by the Resident Engineer of the works (Mr. R. T. Martin), who kindly afforded all information desired.

THE LEAKAGE AT THE ECCUP RESERVOIR OF THE LEEDS CORPORATION.

THE REPORTS OF THE ENGINEERS.

A Special Meeting of the Water-Works Committee of the Leeds Corporation was held last Tuesday—Alderman Woodhouse, the Chairman, presiding—to consider the report of Mr. G. H. Hill, C.E., of Manchester, as to the condition of the Eccup reservoir, and the works necessary to be carried out in order that the leakage may be allayed. In April last, Mr. Hewson, the Borough and Water Engineer, presented to the Water-Works Committee a report dealing with the matter. The water escaping was discoloured; and Mr. Hewson, in his report, stated that he was of opinion that the discolouration arose from the water escaping from the reservoir wearing away the puddle wall. He was confirmed in this opinion by the fact that the surface of the carriage-way which runs along the top of the puddle wall showed at one particular portion a continuous sinking, which was not at all like the natural settlement of a puddle wall. The rocks under the shallow puddle wall Mr. Hewson believed to be fissured; thus permitting the water of the reservoir to escape through them. He thought the channels were formed in the face of the deep puddle wall; and the escape of the water caused the puddle to be abraded and carried away. He did not apprehend any immediate danger; but advised the Committee not to attempt to raise the water in the reservoir, much less to fill it, without first taking the necessary measures either to prevent the leak wearing away the puddle wall, or to do away with the leak altogether. The first of these objects, he said, could be obtained by disregarding the loss of water by the leak, and building a concrete wall along the face of the deep and shallow parts of the puddle wall, where, on examination, the puddle was found to have been worn. Where this was done, Mr. Hewson pointed out, the escaping water did not abrade the puddle wall; but flowed on the face of the concrete, and, escaping, did no harm to the reservoir. The second of the objects named, which would save the water lost by the leak, and prevent injury to the reservoir as well, could be attained by sinking the shallow puddle wall to the depth of the deeper one, and throwing out from the end of it a wing trench also to the depth of the deeper puddle wall. Of these two plans, Mr. Hewson advised the Committee to adopt the latter one. As to the works involved in that plan, he calculated that they could be completed in eighteen months, and estimated the maximum cost at £15,000. In the event of either of these schemes being adopted, the Eccup reservoir would have to be completely emptied, and the supply of water from the Washburn would have to be carried across the reservoir to the valve-shaft of Blackmoor Tunnel by pipes, for which purpose the old conduit would be utilized. For the purpose of more rapidly filling the Eccup reservoir and utilizing the pumping power at Arthington, the Committee were authorized by the Council some time ago to lay a new 30-inch main from the Arthington pumping-station to Eccup, at the estimated cost of £21,120. Within nine months this main will be completed; and it will enable the Committee, under almost any contingency, to send more water to Leeds than would be required. The water-tight wall which Mr. Hewson advised the Committee to build in place of the present shallow puddle wall, and the proposed wing trench, would consist of concrete; but the clay forming the present shallow puddle wall, he proposed to put back into its present position on the top of the concrete wall, which he should, in that case, only build from the level of the bottom of the deep puddle wall to the bottom of the present shallow puddle wall. These trenches would not be in the artificial embankment, but in the rock; and, in Mr. Hewson's opinion, would, therefore, be of the safest and plainest character. Mr. Hill's report (which confirms that of Mr. Hewson) states that he paid two visits to the reservoir with the last-named gentleman, on May 2 and June 25; the last visit being after a conference with Messrs. Filliter and Rofe in London on June 16. He proceeds to allude to the construction of the puddle wall and to the leakage and borings; remarking that the boreholes first put down appear to have been the most effective in reducing the quantity of leakage, but since the autumn of last year there has been an increase in the leakage. The boring, he says, seems to give very uncertain results; and after the experience of the 79 holes now put down, it is impossible to say to what extent boring would have to be continued, and whether it would in the end ensure a complete cure, or reduce the leakage to such an extent as to be immaterial. The levels at which the water has been lost in sinking the boreholes will probably give an indication of the level at which the water leaks away from the reservoir. This level corresponds with the bed of rock which lies under the strata upon which the higher or southern part of the trench is founded; and he agrees in the opinion that it is through this rock the escape of water takes place, but whether the whole of the water passes that way he is unable to say. His attention has been naturally most taken by the settlement in the embankment at and about the valve-shaft; for whatever may be the circumstances connected with the leakage, it is clear that the portion of the embankment most injuriously affected by it is at this point. It is possible that the colour of the water leakage may arise from water entering the strata, and from the waste of material at this place; and that the water afterwards escapes through the rock and under the southern part of the trench, without further affecting the puddle wall beyond. It is, however, singular that other portions of the puddle wall, at and about the stepping up of the trench south of the shaft, which is in contact with this rock, should not be touched; for he is of opinion that no injury has been done to the puddle wall at this point, as a waste of material would soon show itself on the surface. The indications at the top of the embankment, at and about the valve-shaft, show the settlement to be along the inner edge of the puddle wall, and to extend mainly in a northerly direction, and but for a short distance to the south, and the drag of the material is towards the south. He is of opinion that, in order to judge as to the best course to adopt to deal with this particular part of the work, it will be necessary to sink a shaft between the existing valve-shaft and the main puddle wall. Further, if the leakage under the part of the main trench, south of the stepping up of the bottom of the trench, were dependent upon what might be required at the valve-shaft, it would be desirable to postpone doing anything in that part of the work till the examination at the valve-shaft is completed. But as the leakage is believed to be through the rock in other parts, and but partially dependent upon any leakage from the direction of the valve-shaft, it appears, he says, that to stop the leakage under the southern portion of the trench, the trench will require to be opened out, and sunk through the bed of rock into the shale, in which the deep part of the trench at and about the valve-shaft is founded. In the course of the proceedings at the meeting, the Borough Engineer pointed out that, by doing away with the leak by sinking the shallow puddle wall, and so preventing a run of water in the reservoir, very likely the cause of the sinking in the embankment would be removed. The following resolution was adopted:—"That the Borough Engineer be instructed to proceed forthwith with the work necessary for lowering the present shallow puddle wall, as recommended in his report presented to this Committee on the 12th of April last, at the same time making provision for conveying the water to Leeds by means of pipes carried across the reservoir and connected with the Blackmoor Tunnel, and that he also obtain tenders for the excavating portion of the work; the puddling and concreting being done by the workmen of the Corporation." Nothing was said by Mr. Hill in his report with reference to the proposed wing trench; and the Town Clerk was instructed to write to him asking his opinion on the matter. At the meeting of the Water Committee last Friday, Mr. Hill's reply was read. He expressed the opinion that the question as to the necessity for the wing trench should remain over until, in the sinking of the shallow trench to the deeper level, the strata could be seen. He added that he had been informed by Messrs. Filliter and Rofe that the strata improved towards the southern end of the trench; but if the end was not found satisfactory, the direction in which the trench should be continued could then be best determined. Mr. Hewson having reported his agreement with Mr. Hill's suggestion, it was resolved that the work should be carried out in accordance therewith.

THE NEW WATER-WORKS FOR VIENNA.

In previous issues of the JOURNAL (Vol. LIII., pp. 570, 614), references have been made to the new scheme of water supply which has been projected for Vienna. A recent number of *Industries* contained an account of the scheme (which, it may be remembered, has been personally investigated by Mr. John Aird, M.P.), together with a plan of the route to be followed by the line of pipe; and we reproduce therefrom the following particulars:—

The town of Vienna is now served with water brought in an aqueduct from high-level springs in the Alpine range on the south; and as regards quality, the supply leaves nothing to be desired. In respect to quantity, however, very shortly after the opening of the water-works, it became obvious that the supply would, in a few years' time, not be sufficient for Vienna and its suburbs. This time has already arrived. The works are owned by the municipal authorities, who are making great exertions to augment their supply by the acquisition of other springs in addition to that of the Styxenstein and some other Alpine springs, which are now the principal sources. But, owing to a very peculiar and onerous state of the law as regards water rights, there appears to be little hope that the town will be able to effect any material improvement until the law has been altered; and of this there is no prospect. Vienna and its suburbs (the latter especially) are thus rapidly approaching a time when there will be something like a water famine, which will be most severely felt in winter, when the supply is most limited. In summer, the high-level Alpine springs yield a rather more copious supply, owing to the melting of the snow and ice on the mountains. At the present time about 90 per cent. of the houses in the city of Vienna receive their water from the high-level springs; and eleven of its suburbs, containing 412,706 inhabitants, obtain theirs only by means of 220 public fountains—the quantity distributed being 840,000 gallons in summer, and 760,000 gallons in winter. Therefore the average supply per head of the population in the suburbs is in winter only 1·87 gallons per day—an amount totally inadequate; and the bulk of the water required in the suburbs is obtained from local wells, and is therefore of very inferior quality. This condition of things has led to the formation of a new Company for the supply of Vienna, and especially of its suburbs, with potable water derived from a district about 30 miles south of Vienna, where an almost unlimited supply is available; and on the 1st of February last, the Company obtained from the Austrian Minister of Agriculture the concession for the necessary works, which will in magnitude rival the original water-works of Vienna. The water will be obtained from the region to the south-west of Wiener Neustadt, known as the Steinfeld, which consists of an immense deposit of alluvial gravel resting upon an impermeable stratum, and covered by permeable layers of later formation. The water, coming from a very large basin lying on a higher level to the south of this bed of gravel, runs through it to the Danube; and the intention is to catch a portion of the water thus flowing underground by means of a transverse collecting gallery nearly 4½ miles in length, and measuring, in cross section, 10 feet wide by 15 feet high. This gallery dips slightly towards Wiener Neustadt, where the water will be discharged into a reservoir, and then be led in cast-iron mains to Vienna.

The water obtained from the Steinfeld will be distributed throughout 88 parishes, which are at present only inadequately, or not at all supplied from the existing aqueduct. The total quantity of water estimated for

the supply of these parishes, which contain 723,764 inhabitants, is about 23 million gallons per day, or nearly 32 gallons per head. The principal supply will be by gravitation only; the difference of leve between the Steinfeld, the principal reservoir, and the storeage reservoir on the Wienerberg, close to Vienna, being about 100 feet, which is sufficient for the purpose. A few of the parishes on the route of the main-pipe lie, however, at a higher elevation; and these will be served by pumping-stations. There will be in all ten such stations, serving 26 parishes; whilst the remaining 62 parishes will receive the water by gravitation. The total amount of steam power required is estimated at 815-horse power, inclusive of reserve plant. Eventually, pumps representing 335-horse power will be erected, when the demand has exceeded the present requirements to this extent. In most of the pumping stations, the machinery will only be at work during the day; but in the station at Wiener Neustadt, the pumps will work night and day, as the topographical conditions of the district do not admit of the erection of a high-level reservoir. There are in all 18 reservoirs, varying in capacity from 11,000,000 down to 11,000 gallons; and cast-iron mains will be used throughout—the diameter varying from 52 down to 3 inches.

Perhaps the most interesting part of the work will be the construction of the collecting gallery. The floor of this will be from 50 to 90 feet below the surface of the ground; and a novel method of excavating and placing the concrete sections of the tunnel in position has been elaborated by the Company's Engineers. Having staked out on the surface the course of the gallery, a double line of rails will be laid to the right and left of the line, at a sufficient distance apart to allow for an open cutting being made between the line of rails down to the required depth. The cutting will be made by the aid of steam-navvies running on these rails. Three navvies will work in succession. The first, which will excavate to about a third of the total depth, is to be of the usual type employed for cutting out the slope of the bank of a canal; the only difference being that the ladder with the dredger buckets, instead of being thrown out on one side, is arranged in the middle. The material excavated will be shot direct into trucks, and taken away to be afterwards used in filling in again. The second excavator is to be a dredger of special construction, and will deepen the cutting by another third. The material excavated will not be brought directly to the surface, but will be shot into an elevator working in a central vertical tube, and thence conveyed up to the trucks. The third excavator which will complete the cutting down to the total depth, is to be of similar construction, with the only difference that the elevator will have to lift from a greater depth. These steam navvies are intended to be supported on transverse bridges of about 160 feet span, and part of the work of excavation will have to be done under water. In these circumstances, the placing of the sections of the collecting tunnel, if to be done by hand, would require the employment of divers; and to obviate this, it is proposed to lower the sections into place by means of two steam-cranes following the steam-navvies. These sections are made of concrete, supported by an iron framework, in 6 ft. 6 in. lengths. They will simply be placed in line side by side; and the lower part of the joints made good by a filling-in of cement concrete on the outside from a fifth staging which follows the cranes. The cement concrete will be conveyed down to the space between the tunnel and the side walls of the cutting by tubes depending from this stage; and the same apparatus is to be used for filling in over and above the tunnel the previously excavated gravel to a height of 6 feet. The remainder of the cutting will be filled up direct from tip waggons. It is estimated that the whole of the work will be done in about two years; so that the new water supply will be available in 1892.

Sale of Shares.—Last Wednesday, Mr. R. Waterer sold by auction, at Chertsey, five fully paid £10 shares in the *Chertsey Gas Company* for £11 5s. per share, and five similar shares for £12 each.

Northern Coal Trade.—There was a fuller demand for coal in the North last week, and the tendency was, on the whole, towards higher prices. For steam coal, the shipments are now heavy—the Baltic being entirely open; and the price is maintained at 9s. 6d. per ton. For gas coal, the demand begins to grow; and there are all the signs of a very full winter's delivery beginning to set in. Some of the local contracts that have been recently placed have been at prices fully 1s. 6d. per ton above those they replace.

Proposed Gas-Meter Inspector for Middlesex.—At the meeting of the Middlesex County Council last Thursday, a proposition was brought forward by Mr. Melluish to refer to the General Purposes Committee the question of the appointment of an inspector of gas meters for the county. Mr. Gripper (Chairman of the Committee) said the Committee had already discussed the subject, and they found that the Gas Companies afforded facilities to their customers for the testing of their meters; and therefore the Committee did not feel justified in recommending the Council to incur the considerable annual expenditure which the appointment of an inspector would necessitate. Mr. Melluish said at present the consumers were quite in the hands of the Gas Companies. The great majority of them hired meters of the Companies, and had no means of telling whether they were correct or not. The Chairman (Mr. Littler, Q.C.) said that as the law stood any consumer had the option of providing his own meter, and he could have it tested at any time. If, when a meter was tested, it were found to be correct, the consumer had to pay the cost, whereas if it was incorrect, the Gas Company had to bear the expense; and both parties had to abide by the result. After some discussion the Council decided that it was not desirable to appoint an inspector.

The Warwick Town Council and the Gas-Works.—At the meeting of the Warwick Town Council last Tuesday, Alderman Smith submitted the following proposition:—"That, as it appears the opinion of many inhabitants of this borough that the Warwick Gas-Works ought to become public property in the hands of the Town Council, so that the ratepayers may participate in the profits, and in order to have the question properly investigated, the Mayor shall be requested to select a Committee from the Council; but I respectfully request his Worship to exclude any member being a gas proprietor." He said that the question was not a new one—it had come before the Corporation on several previous occasions. He had corresponded with Leicester and Coventry, and had some information to lay before the Council; but he did not consider it advisable to disclose it at that juncture. He had had it intimated to him that the Directors of the Gas Company were disposed to meet the Corporation on fair and equitable grounds. If the Council granted him a Committee to investigate the whole question, he should ask them to consider, in the first place, whether or not it was desirable to take over the gas-works at all, and, secondly, if it was desirable, to determine how the money should be obtained. Unless the price met with the approbation of the Committee, they need not proceed in the matter. The proposition was adversely criticized by Alderman Stanton and Mr. Boddington—the latter gentleman arguing that the purchase of the gas-works would mean increased taxation; and eventually the matter fell through.

NOTES FROM SCOTLAND.

(FROM OUR EDINBURGH CORRESPONDENT.)

Edinburgh, *Saturday*.

The first step in a movement for the acquisition of the Dunfermline Gas Company's undertaking by the Town Council was taken on Monday, when, at a meeting of the Council, Mr. Scobie moved—"That a Committee be appointed, with instructions to investigate generally into the working of gas-works held by Corporations, ascertaining their financial aspects as well, and to report on the whole subject, with a recommendation as to what steps should be adopted, having reference to the application of such a scheme for our own town." He believed, he said, that it would be to the interest of the ratepayers to acquire the works. Had the works been taken over 16 or 17 years ago, as was then proposed, and strongly advocated, the Corporation would have had at least one valuable asset in their possession; and if the gas had not been cheaper than it was at present, they would have been able from time to time to have realized a surplus for public purposes. He had written to the managers of 26 gas undertakings in order to ascertain details of the working of such concerns in the hands of public bodies, and had received acknowledgments from 14 of them. To his mind, they all went to show that gas and water works should be in the hands of public authorities. Kilmarnock acquired their works in 1872 at £44,000, which was a very high price indeed. At the transfer the price of the gas was 5s. 10d. per 1000 cubic feet; now it was 3s. 6½d. The capital stood at £30,000; and the value of the works at £50,000. The surplus in 1838 was £3649; and in May last £3000 of debenture bonds were paid off. The works at Perth were transferred in 1871 at £45,000. This was another exorbitant figure; but the price of the gas had been reduced from 5s. 10d. to 3s. 4d. per 1000 cubic feet. After meeting all liabilities last year, they had £1500 surplus to be disposed of. The price of gas in Dundee in 1869 was 5s. 4d.; it was now 3s. 6d.; and the Council were always adding to the value of their works from revenue. The price at Aberdeen in 1871 was 5s. 5d.; it was now 3s. 6d.; and the works were increasing in value. The present price at Greenock was 3s. 6½d.; and the surplus was applied to reduce the rates. Arbroath, Broughty Ferry, Peterhead, Rothesay, Inverness, and Elgin were all exceptionally situated or burdened through expensive transfers and other causes; but with their disadvantages and responsibilities they were prosperous, and all had reduced the price of gas on an average of fully one-third. Alloa began in 1877 with a responsibility of £26,200; and this was now reduced to £19,025. The price of gas had been reduced from 4s. 7d. to 3s. 4d. This was also considered a somewhat dear transfer; and yet, with good management, they had effected a large reduction in about 13 years, and added to the value of their works. The Paisley Gas-Works were acquired in 1870. This seemed to be a most successfully managed undertaking; for while their gas was at the low figure of 2s. 10d. per 1000 cubic feet, nearly all the extensions and improvements were made out of profits, besides handing over the handsome sum of from £3500 to £5000 annually to the Town Improvement Commissioners. After a long discussion, Mr. Scobie withdrew his motion, and substituted the following, which was unanimously agreed to:—"That a Committee be appointed to inquire into the whole subject of lighting, whether by coal gas, water gas, electricity, or other mode of artificial lighting, and specially as to the working of gas-works in the hands of corporations, and to report."

The annual accounts of the Arbroath Gas Corporation for the year show a surplus of about £17, which is not large; but during the year £400 has been paid towards the suspense account, to which the total cost of new engines and boilers was transferred a few years ago. It is expected that, in consequence of the favourable state of the accounts, the price of gas will this year be reduced 2½d.; making it 3s. 11½d.

The profits of the Kirkcaldy Gas Company for the past year amount to £3754, out of which it is proposed to pay the annual dividend of 7s. 6d. per share. The Directors also recommend that the price of gas be further reduced from 3s. 4d. to 3s. 1½d. per 1000 cubic feet.

The accounts of the Alloa Gas Commission for the year ending May 15 show a total revenue of £5517. The expenditure amounted to £4655; leaving a profit of £862.

The Broughty Ferry Corporation gas undertaking did well last year. At a meeting of the Police Commissioners last Monday, Mr. Matthew, the Convener of the Gas Commissioners, reported that during the year they carbonized 2336 tons of coal, and produced therefrom 25,776,900 cubic feet of gas, giving 11,035 feet per ton of coal. They delivered to the consumers 24,127,761 feet; showing a leakage of 6·39 per cent., as against 8·17 and 6·81 for the two previous years. The increased consumption by the public lamps was 248,300 feet. The total revenue from all sources was £4852; and the expenditure, including £175 as sinking fund instalment, £4441, showing a surplus of £410. It was agreed to abolish meter-rents, as well as a charge of 5s. each for public lamps.

The income of the Peternead Gas Commissioners last year was £3844; being an increase of about £170. The expenditure was £3625, as compared with £4837 in the previous year—there being a profit of £475 upon the year's working. It was decided to reduce the price of gas from 6s. 3d. to 5s. 10d. per 1000 cubic feet.

The accounts of the Elgin Gas Commissioners for the past year show that the output of gas rose from 13,122,050 feet in the year ending the 15th of May, 1888, to 13,338,500 last year. The price of the gas was reduced about a year ago from 5s. 10d. to 5s. 5d. per 1000 cubic feet; and the amount realized last year was consequently only £3613, as compared with £3809 in the preceding year. The profit for the year was £724. The Commissioners at their meeting last Monday, resolved to reduce the price of gas from 5s. 5d. to 5s. per 1000 cubic feet.

(FROM OUR GLASGOW CORRESPONDENT.)

Glasgow, *Saturday*.

By inadvertence, the price of gas for the current year at Hawick was given in last week's "Notes" at 3s. 2½d. per 1000 cubic feet; the actual fact being that the price was continued at 3s. 1½d. per 1000 feet, as in the year 1888-9. Of course, the usual discount to consumers was also continued; this ranging up to 7½ per cent.

At the monthly meeting of the Johnstone Police Commissioners last Monday, the abstract financial statement of the Corporation gas undertaking for the past year was submitted. It showed a net profit on the year's transactions of £1308, and after laying aside sufficient to pay the interest and sinking fund falling due in September, 1889, and March, 1890—together amounting to £622—there was left a surplus balance of £686. It was resolved to reduce the price of gas by 5d.; making it 3s. 11½d. per 1000 cubic feet.

An abstract statement of the Port-Glasgow gas accounts for the year ending May 15, 1889, shows that the total income was £4731; and the expenditure £3992. There was thus a balance, being net profit, of £738. The make for the year was 22,897,600 cubic feet of gas, the average illuminating power of which was 26 candles. The unaccounted-for gas over the year was 11 per cent., as against 15 per cent. Surely, it is time now for the Corporation Gas Commissioners in the "Port" to reduce the

price of gas to a lower point than 4s. 6d. per 1000 feet, which has been the rate for at least three years. In the adjoining burgh of Greenock, the price is 3s. 6½d. per 1000 feet.

So far as Scotland is concerned, a somewhat novel experiment is about to be made by the Directors of the Barrhead Gaslight Company. With the view of encouraging their customers to consume gas for cooking and heating purposes, they have announced their willingness to allow an abatement of 17½ per cent. off all accounts for gas used in the way mentioned, if measured by special meter; thus bringing the price down to 3s. 5½d. per 1000 cubic feet.

The statement of revenue and expenditure of the Greenock Gas-Works for the year ending the 30th ult. has just been made up, and shows a surplus of above £2000. It was thought, when the probable income and expenditure for the year were estimated, that, with a reduction of 2½d. per 1000 cubic feet in the price of gas, there would be a surplus of about £1500; so that the actual gain is much over the estimate. The amount saved will likely, as in former years, be put to the general account of the Police Board to keep down taxation. This step, however, may meet with opposition from a section of the Board members, who deprecate what they call an unjust system of paying over the gas profits to relieve the taxes of the general ratepayers, many of whom dispense with the use of gas, to the detriment of those who use it. In view of the surplus revenue, the price of gas would very likely be reduced by another 2½d. per 1000 cubic feet. This, of course, will only be the case if the present system of charging for gas is continued; but at the present time the gas officials are preparing tables to show the number of tenants and others who are liable for police rates, and also the number of those who burn gas and those who do not. The object in view in the table is to ascertain what sum per pound would have to be imposed upon the ratepayers if it should be thought better to raise by taxation the expenditure necessary for the new gas-works. The table in question will be laid before the Committee on an early date.

The Kirkcudbright Gas Commissioners, at their annual meeting last Monday, had under consideration the statement of accounts for the year ending May 15. It showed a deficit on the year's working of £40, which was attributed to the early closing of the hotels and public-houses. As there was a surplus of £230 in the preceding year, the deficit for the past year was deducted; and it was agreed to continue the price of gas at 6s. 3d. per 1000 cubic feet, as compared with 6s. 8d. in 1886 and 1887.

A dividend of 6 per cent. has been declared by the Castle-Douglas Gas Company.

The annual general meeting of the Stirling Gaslight Company was held last Tuesday, when the usual dividend was declared and the directorate was reconstituted.

The financial statement of the Kilmarnock Gas undertaking will show a profit on the past year's turnover, amounting to £2400.

Owing to the approach of the annual fair holidays, there has not been much business done this week in the Glasgow pig-iron market; indeed, business has been altogether suspended since mid-day on Thursday, when up to 44s. per ton cash was paid for Scotch warrants; the close, however, showing a slight decline.

The coal trade has been somewhat more active in some quarters; but the steam coal branch is suffering to a certain extent through a lessened consumption and export. For furnace works there is a large demand, in which there are no signs of abatement.

CURRENT SALES OF GAS PRODUCTS.

LIVERPOOL, *July* 13.

Sulphate of Ammonia.—Some uneasiness seems to prevail among makers in the largest (during the summer) centre of production—viz., in Scotland; for £11 15s. f.o.b. Leith is being accepted for 24½ per cent. quality, and the feeling in the northern markets does not appear by any means to be a strong one. The tone at Hull and Liverpool remains more steady, because there is no large quantity offering; and in this neighbourhood especially, "fancy" prices have been paid to supply orders for immediate shipment for the Spanish and African markets. At Hull there appear to be buyers at £11 15s. As regards future delivery, there are still speculative buyers on the basis of to-day's values; but consumers have adopted very cautious tactics. Their present wants are fairly supplied; and they could only be tempted to enter into future engagements at reduced prices. The nitrate market has once more assumed a quieter tone; and the rise in nitrate shares which has created some stir, seems to be mainly due to the action of the Chilian Government in issuing a decree which makes nitrate property a much safer investment.

LONDON, *July* 13.

Tar Products.—There has not been much change during the week in the value of tar products. Anthracene is firm at 1s. 2d. for "A" quality, and 1s. for "B;" but benzols are weaker—being nominally 2s. 6d. for 90's. and 1s. 10½d. for 50's; but there is very little business doing. Carbolic acid keeps firm at 3s. 9d.; and creosote is in very good demand at former prices. Prices may be taken as follows:—Tar, 23s. to 28s. per ton, according to position. Benzol, 90 per cent., 2s. 6d. per gallon; 50 per cent., 1s. 10½d. per gallon. Toluol, 1s. 4d. per gallon. Solvent naphtha, 1s. 3d. per gallon. Crude naphtha (30 per cent.), 11½d. per gallon. Light oil, 3½d. per gallon. Creosote, 2½d. per gallon. Pitch, 21s. to 23s. per ton. Carbolic acid (60's), 3s. 9d. per gallon. Cresylic acid, 10d. per gallon. Tar salts, 15s. to £1 per ton. Anthracene (30 per cent.), "A" quality, 1s. 2d. per unit; "B" quality, 1s. per unit.

Ammonia Products.—Sulphate has improved somewhat; and to-day's price is from £11 15s. to £12 per ton according to position. Prices of other products are: Gas liquor (5° Twaddel), 7s. 9d. per ton, with a rise or fall of 1s. 6d. per degree. Liquor ammonia, 1½d. per lb. Carbonate of ammonia, 3d. to 3½d. per lb. Muriate of ammonia, brown, £18 10s. per ton; white, £23. Sal-ammoniac, £30 to £32 per ton.

THE NUISANCE OF ELECTRIC LIGHTING MACHINERY.—Last Friday, Mr. Justice Stirling heard a motion by Mr. Foljambe, of 2, Carlton House Terrace, to restrain the Duke of Marlborough, who resides next door, from using in the basement of his house a steam-engine so as to cause a nuisance or danger to the plaintiff's premises by way of noise, vibration, or heat. The engine complained of had been fitted up by the defendant for the purpose of generating electricity to light his house. The plaintiff alleged that while the engine was working the noise and vibration experienced by the occupants of his house constituted a serious nuisance; and that the heat from the furnace, which passed through a flue in the wall of the plaintiff's house, was so great as to cause cracks in the wall and to give rise to imminent risk of setting the house on fire. It was stated on behalf of the Duke that he proposed to connect the furnace with another flue, and to take measures which he was advised would reduce the heat, vibration, and noise, so as to do away with the nuisance complained of; and he offered to give an undertaking in terms of the notice of motion, with certain modifications. This proposal being agreed to by Counsel for the plaintiff, the motion was directed to stand over for a fortnight.

NEW WATER-WORKS FOR BOWLING, NEAR GLASGOW.—The inauguration of the water-works, which have been constructed during the past winter for the supply of Bowling, took place recently. They are designed for a daily supply of 20,000 gallons. The reservoir is situated at a height of 600 feet above sea level, and contains when full 2¼ million gallons. The works were designed by Mr. W. J. Millar, C.E., of Glasgow, and constructed by Messrs. Black and Eadie, of Paisley, at a cost of about £1600.

ISSUE OF ADDITIONAL STOCK BY THE BELGRANO (BUENOS AYRES) GAS COMPANY, LIMITED.—The Belgrano Gas Company are about to issue the balance of £64,000 of 5 per cent. debenture stock, which will be redeemable at a premium of 10 per cent. at any time at the option of the Company, on giving six months' notice, and at the same rate without notice in the event of the Municipality of Belgrano exercising their option of purchasing the Company's works. The present issue is required in order to provide funds for the further extension of the works, necessitated, it is said, by the great increase in the consumption of gas, which in 1888 was 41 cent. over that of 1887, and more than 100 per cent. over that of 1886. Upwards of £60,000 has recently been expended on new plant and the reorganization of the works; but further extensions are necessary to keep pace with the growing demand.

EUROPEAN GAS COMPANY, LIMITED.—The annual meeting of this Company was held yesterday. The Directors, in their report, stated that the depression in the French provinces had been such as to occasion great difficulty in maintaining the consumption of gas at the same favourable rate as in former years. In fact, the aggregate increase of rental at the seven stations of the Company was a fraction under 1 per cent. The Directors are earnestly urging their Managers to do all in their power to promote a more important increase in the consumption of gas by supplying fittings and stoves on hire at a merely nominal rental. On March 31 last, there were 39,099 gas-stoves and 153 gas-engines fixed for the consumers, which yield a large amount of rental. The net profit of the year admitted of a dividend of 26s. per paid-up share; and in the same proportion on the other two series, payable, on the 1st prox., less the interim dividend of 10s. per share paid in February last. After providing for this, a balance of £2397 will remain to be added to the undivided profits. The Chairman, in moving the adoption of the report, made an interesting statement on the affairs of the Company; and he dilated on the question of gas companies assuming responsibility beyond the consumer's meter—stating that in their own case, the Directors believed in looking, not only after the manufacture and distribution, but also after the fittings and burners of their customers. Mr. H. Solomon seconded the motion, which was carried. A full report will be given in the JOURNAL next week.

GAS AND WATER COMPANIES' STOCK AND SHARE LIST.

(For STOCK MARKET INTELLIGENCE, see *ante*, p. 119.)

Issue.	Share	When ex-Dividend.	Dividend or Div. & Bonus.	NAME.	Paid per Share	Closing Prices.	Rise or Fall in Wk.	Yield upon Investment.
£			p. c.	GAS COMPANIES.				£ s. d.
590,000	10	11 Apr.	10½	Alliance & Dublin 10 p. c.	10	18—19	..	5 10 6
100,000	10	„	7½	Do. 7 p. c.	10	13—14	..	5 7 2
800,000	100	1 July	5	Australian (Sydney) 5°/o Deb.	100	109—111	..	4 10 1
100,000	20	30 May	10	Bahia, Limited	20	24—26	..	7 13 10
200,000	5	15 May	7½	Bombay, Limited	5	6¾—7¼	−¼	5 3 5
40,000	5	„	7½	Do. New	4	5—6¼	..	5 9 1
880,000	Stck.	14 Feb.	11½	Brentford Consolidated	100	229—234	..	5 0 5
125,000	„	„	8½	Do. New	100	167—172	..	5 9
220,000	20	14 Mar.	10½	Brighton & Hove, Original	20	43—45	..	4 13 4
320,000	20	28 Mar.	11½	British	20	45—47	..	4 15 9
50,000	10	14 Mar.	11	Bromley, Ordinary 10 p. c.	10	20—22	..	5 0 0
39,000	10	„	8	Do. 7 p. c.	10	13¼—14¼	..	5 10 4
328,750	10	30 May	10	Buenos Ayres (New) Limited	10	15—16	+¼	6 5 1
200,000	100	1 July	6	Do. 6 p. c. Deb.	100	105—108	..	5 11 1
150,000	20	28 Feb.	8	Cagliari, Limited	20	25—27	..	5 18 6
550,000	Stck.	11 Apr.	13½	Commercial, Old Stock	100	265—270	..	5 1 10
130,000	„	„	10½	Do. New do.	100	213—218	..	4 18 8
130,000	„	28 June	4½	Do. 4½ p. c. Deb. do.	100	122—125	..	3 13 0
557,320	20	14 June	13	Continental Union, Limited	20	46—48	..	5 8 4
242,680	20	„	13	Do. New '69 & '72	14	33¼—33¾	..	5 8 5
200,000	20	„	10	Do. 7 p. c. Pref.	20	37—39	..	5 2 6
75,000	Stck.	28 Mar.	10	Crystal Palace District	100	204—208	..	4 16 2
254,060	10	30 Jan.	13	European, Limited	10	25¼—26¼	..	4 18 1
130,000	10	„	13	Do. New.	7½	17¼—18½	..	5 5 3
354,060	10	„	13	Do. do.	5	12¼—13¼	..	4 16 3
5,468,600	Stck.	14 Feb.	13	Gaslight & Coke, A, Ordinary	100	263—267	+1½	4 17 5
100,000	„	„	4	Do. B, 4 p. c. max.	100	100—105	..	3 16 3
665,000	„	„	10	Do. C, D, & E, 10 p.c. Pf.	100	257—262	..	3 16 4
80,000	„	„	5	Do. F, 5 p. c. Prf.	100	123—128	..	3 18 1
60,000	„	„	7½	Do. G, 7½ p. c. do.	100	182—187	..	4 0 4
1,200,000	„	„	7	Do. H, 7 p. c. max.	100	167—171	+1½	4 1 10
468,000	„	„	10	Do. J, 10 p. c. Prf.	100	265—290	..	3 16 11
1,051,150	„	14 June	4	Do. 4 p. c. Deb. Stk.	100	118—121	..	3 6 1
294,850	„	„	4½	Do. 4½ p. c. do.	100	126—130	..	3 9 8
650,000	„	„	6	Do. 6 p. c. do.	100	171—175	..	3 8 6
5,600,000	Stck.	15 May	10	Imperial Continental	100	207—210	+1½	4 15 3
75,000	5	14 June	6	Malta & Mediterranean, Ltd	5	5—5¼	..	5 9 1
560,000	100	1 Apr.	5	Met. of Melbourne, 5 p.c. Deb.	100	113—115	..	4 6 11
541,920	20	14 June	6	Monte Video, Limited	20	19½—20½	..	5 17 1
150,000	5	30 May	10	Oriental, Limited	5	9—9½	..	5 5 8
60,000	5	28 Mar.	7	Ottoman, Limited	5	6¾—6¾	..	5 8 8
166,870	10	16 Jan.	4	Pará, Limited	10	5¾—6	..	6 13 4
420,000	100	2 May	6	People's Gas of Chicago—1st Mtg. Bds.	100	103—107	..	5 12 1
500,000	100	1 June	6	2nd Do.	100	98—102	..	5 17 8
100,000	10	26 Apr.	10	San Paulo, Limited	10	16¾—17½	+½	5 14 4
500,000	Stck.	28 Feb.	16½	South Metropolitan, A Stock	100	317—322	..	5 0 11
1,350,000	„	„	12½	Do. B do.	100	240—244	+4½	4 19 4
141,500	„	„	13½	Do. C do.	100	260—270	..	4 18 1
600,000	„	28 June	5	Do. 5 p. c. Deb. Stk.	100	137—142	+2	3 10 5
60,000	5	28 Feb.	11½	Tottenham & Edm'ntn, Orig.	5	11—13	..	4 8 5
				WATER COMPANIES.				
717,467	Stck.	14 June	9½	Chelsea, Ordinary	100	265—270	..	3 10
1,730,560	Stck.	11 Apr.	7½	East London, Ordinary	100	207—211	..	3 11
544,440	„	28 June	4½	Do. 4½ p. c. Deb. Stk.	100	140—143	+1½	3 2 1
700,000	50	14 June	9	Grand Junction	50	128—138	+1½	3 10 4
708,000	Stck.	14 Feb.	10½	Kent	100	272—277	..	3 15 9
1,043,800	100	28 June	9	Lambeth, 10 p. c. max.	100	253—258	..	3 9 9
406,200	100	„	7½	Do. 7½ p. c. max.	100	200—208	..	3 13 10
200,000	Stck.	28 Mar.	4	Do. 4 p. c. Deb. Stk.	100	119—122	..	3 5 7
500,000	100	14 Feb.	12½	New River, New Shares	100	355—360	..	3 7 4
1,000,000	Stck.	30 Jan.	4	Do. 4 p. c. Deb. Stk.	100	127—130	..	3 1 6
902,300	Stck.	28 June	6	S'thwk & V'xhall, 10 p.c. max.	100	174—178	+2½	3 7 5
1,126,500	100	„	6	Do. 7½ p. c. do.	100	164—169	+3	3 11 0
155,066	Stck.	14 June	10	West Middlesex	100	262—267	..	3 14 11

THE ADVANCE IN THE PRICE OF COAL.—As an illustration of the advance which has lately taken place in the price of coal, the Gas Committee of the Middlesbrough Corporation have contracted for 35,000 tons at an average of 10s. 4½d. per ton, against an average of 8s. 4½d. per ton for a like quantity last year.

THE MANAGEMENT OF THE HEYWOOD GAS-WORKS.—The question of the management of the gas-works led to a brief discussion at the meeting of the Heywood Town Council last Thursday. The Gas Committee reported that the Manager (Mr. H. Hawkins) had offered to accept a commission of 7½ per cent. on the net profits, in lieu of his present salary; and they recommended that this should be agreed to, subject to the confirmation of a special meeting which all the members of the Council were invited to attend. At this special meeting a resolution in favour of the recommendation was proposed; but, on a vote, only five were in its favour.

COMPLAINT OF OFFENSIVE SMELLS FROM THE PIMLICO GAS-WORKS.—At the meeting of the Works Committee of the Vestry of St. George's, Hanover Square, last Tuesday, the Medical Officer of Health (Dr. Corfield) reported upon certain complaints which had been received from a number of parishioners residing in the neighbourhood of the Lupus Street works of The Gaslight and Coke Company, respecting disagreeable smells emanating from the works. He said the Company took every precaution they possibly could to prevent the works being dangerous to health, and, although the smells complained of might be offensive, he could not declare them to be a nuisance. He doubted whether the Vestry, as a sanitary authority, could sustain an action against the Company in respect thereof. The only means of redress was by an injunction. It was decided that a copy of the Medical Officer's report, should be sent to those who had complained to the Vestry of the nuisance.

BRENTWOOD GAS-WORKS, ESSEX.—The extension and re-arrangement of these works, which has lately been carried out for the Board by their Consulting Engineer, Mr. Jabez Church, M. Inst. C.E., of Westminster, has just been completed. The average annual increase in the consumption of gas in the town and district (which also includes the Warley Barracks and other large establishments) has for some time past been about 10 per cent. Owing to this, as well as to a contract entered into for the supply of a very large additional quantity of gas to the new County Lunatic Asylum, the Company's works were inadequate to meet the demands upon them; and hence the extension. The ironwork contract, including new gasholder, engine and exhauster, additions to the scrubber and condenser, together with enlarged connections throughout the works, has been satisfactorily carried out by Messrs. Willey and Co., of Exeter; and the contract for the tank, wharf wall, and other brickwork, by Messrs. Holme and King, of London and Liverpool.

CONSTANT WATER SUPPLY FOR CRIPPLEGATE.—At the meeting, last Thursday, of the Court of Common Council of the City of London, the Gas and Water Committee recommended that the request of the Vestry of Giles's, Cripplegate, for a constant supply of water to the district of Cripplegate Without be complied with, and that the New River Company be requested to give effect to the wishes of the memorialists, upon the Company being satisfied that the proper preliminary steps had been taken by the consumers to ensure the prevention of waste. Mr. G. C. Edwards moved the adoption of the report, and said the parish had been agitating ever since 1885 for a constant supply of water. Dr. Crosby asked if there was any appeal against the Water Company's mode of providing the supply. The City Solicitor said the Companies were bound under the regulations contained in the Metropolis Water Act, 1871. The Lord Mayor observed that the New River Company were perfectly ready to afford a constant supply to any parish asking for it. He wished to assure Dr. Crosby that the Company had no desire to resort to arbitrary measures. The motion was adopted.

GAS EXHIBITION AT WANTAGE.—Since the installation of Mr. F. G. Dexter as Manager of the Wantage Town Commissioners' Gas-Works, a number of much-needed reforms have been carried out, which cannot fail to be for the general good of the undertaking and of the gas consumers. A short time ago, Mr. Dexter advised his Committee to have a gas exhibition, to let cooking-stoves on hire, and to reduce the price of gas 10d. per 1000 cubic feet. In these recommendations he had the cordial support of his Chairman (Mr. J. G. Candy); and as the result, they were adopted. The exhibition was held in the Town Hall from the 18th to the 21st ult. The entire arrangements were carried out by Mr. Dexter, who brought together a very good collection of appliances. The exhibits comprised gas cooking-stoves, gas-fires, boiling-burners, heating-stoves, grillers, hot-plates, workshop tools, furnaces, and other utensils to which gas can be applied as a heating power, supplied by Messrs. T. Fletcher and Co.; in addition to which there were various types of modern burners, lamps, &c. Miss Bowern was engaged to give a series of lectures on cookery; and on each occasion had an attentive audience. The whole thing, owing to the spirit in which it had been carried out, was a thorough success.

GWYNNE & CO., ESSEX STREET WORKS, VICTORIA EMBANKMENT, LONDON, W.C.

GWYNNE & BEALE'S PATENT GAS EXHAUSTERS & ENGINES.

Telegrams: "GWYNNEGRAM, LONDON." Telephone No. 2698.

Exhausters of nearly all sizes in Stock.

Prize Medals at all the Great International Exhibitions.

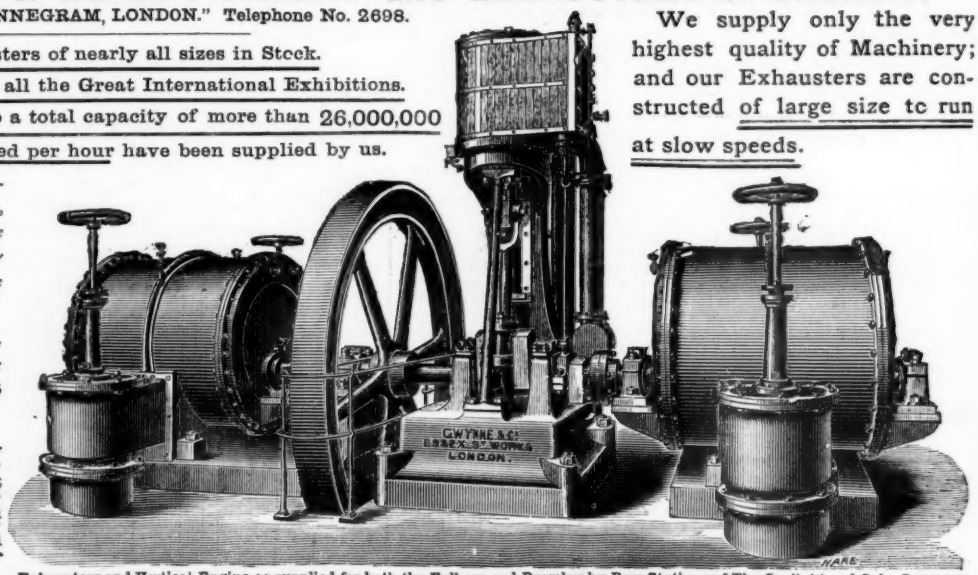
Exhausters equal to a total capacity of more than 26,000,000 cubic feet passed per hour have been supplied by us.

We supply only the very highest quality of Machinery; and our Exhausters are constructed of large size to run at slow speeds.

Our new Patent Non-Fluctuating Exhausters, to work without the slightest oscillation or variation in pressure, are strongly recommended.

MAKERS OF EVERY DESCRIPTION OF HYDRAULIC AND GAS MACHINERY.

Gwynne & Co.'s New Catalogue and List of Testimonials can now be obtained on application.



Exhausters and Vertical Engine as supplied for both the Fulham and Bromley-by-Bow Stations of The Gaslight and Coke Company.

OXIDE OF IRON.

O'NEILL'S Oxide has a larger annual sale in the United Kingdom than all other Oxides combined. Purity and uniformity of quality guaranteed. Pamphlet, "How to Purchase Bog Ore," to be obtained on application.
Gas Purification and Chemical Company, Limited, Palmerston Buildings, Old Broad Street, London, E.C.
JOHN WM. O'NEILL, Managing Director.

ANDREW STEPHENSON, Agent for the GAS PURIFICATION AND CHEMICAL COMPANY, Limited, Palmerston Buildings, Old Broad Street, LONDON, E.C.

CANNEL COAL, &c.

JOHN ROMANS & SON, EDINBURGH.
Gas Engineers, supply all the most approved SCOTTISH CANNELS; also FIRE-CLAY GOODS, CAST-IRON PIPES, and other APPARATUS for GAS AND WATER WORKS.
Prices, &c., will be forwarded on application to No. 30, ST. ANDREW SQUARE, EDINBURGH, } SCOTLAND.
No. 54, BERNARD STREET, LEITH, }

ENGINEER and Draughtsman, with special knowledge of Gas and Chemical Works (has been engaged upon Works in England and abroad), desires permanent Position as ENGINEER'S ASSISTANT or DRAUGHTSMAN in large Works or Firm. Would proceed to India or Colonies under agreement. Age 33.
Address No. 1723, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

TIMMIS & CO., of STOURBRIDGE
Make only the best quality of FIRE-CLAY RETORTS, BRICKS, TILES, & LUMPS. Also SPECIAL SILICA BRICKS, to stand great heats.
All descriptions kept in Stock.
For Prices apply to JAMES LAWRIE AND CO, 1, Whittington Avenue, Leadenhall Street, E.C., Sole Agents for London and District.
Telegraphic Address: "EIRWAL, LONDON."

W. C. HOLMES & Co., Huddersfield, AND 80, CANNON STREET, LONDON,
Contractors for Gas-Works complete, Makers of Gasholders, Purifiers, Scrubbers, Condensers, Retort Fittings, &c., Improved Valves, Engines, and Exhausters. Also for Collingwood's Regenerative Retort-Settings.
*** See Advertisement p. 99 of last week's issue.
Cablegrams: "Ignitor London." Telegrams: "Holmes Huddersfield."

J. & J. BRADDOCK, Globe Meter Works, Oldham.
First-Class Award. Melbourne Exhibition, 1889, for Wet and Dry Gas-Meters, Station Meters, and Governors, Pressure-Gauges, Street Lamps, and Pillars, &c.
Telegraphic Address: "Braddock, Oldham."

WANTED Employment. Can do Service Laying, Indoor Fitting, and Circular or Plain Glazing. A practical all-round hand. In present employment Ten years.
Address, G. R., 16, St. George's Road, REGENT'S PARK, N.W.

IRISH BOG ORE OXIDE OF IRON.

GAS PURIFICATION.

BALE, BAKER, & CO., direct Importers from Ireland. Sample and Price on application. Spent Oxide and Sulphate of Ammonia purchased.
120 and 121, NEWGATE STREET, LONDON, E.C.

SULPHURIC ACID.

JOHN NICHOLSON & SONS, Chemical Works, LEEDS, specially produce this ACID for making SULPHATE OF AMMONIA of high quality and colour. *Delivery in Railway Tank-Wagons or Carboys.*
Highest References and all particulars supplied on application.

TO CORPORATIONS AND LIMITED WATER COMPANIES.

THE Manager and Secretary of a Water- Works desires RE-ENGAGEMENT. Has life-long experience, and is thoroughly qualified to take full charge of any Water-Works, both indoor and outdoor work; experience in both large Corporations and Limited Company. Prepared to give the highest references, both as to qualifications and character, and most satisfactory reasons for desiring re-engagement. Security to any amount.
Address No. 1716, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

WANTED, a good Foreman Gasholder Erector.
Apply to SAML. WHILE, 60, Queen Victoria Street, LONDON, E.C.

WANTED, Two good Retort Setters for Country Work.
Apply by letter, to No. 1725, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

THE Ascot District Gas Company require a RESIDENT MANAGER. He must have had experience in the Indoor and Outdoor Management of a Gas Company, and will be required to keep Rental Accounts, and Collect and find Sureties. Applicants to state Age, previous Engagements, and Salary expected, on or before Saturday, the 20th inst.
Address the SECRETARY, Ascot District Gas Company, Moorgate Street Chambers, MOORGATE STREET, E.C.

WANTED, a Gas-Fitter, not over 25 years of age, to proceed to Ceará about the middle of August. He must be expert in Compo. and Iron Pipe Work, as well as in the general Iron Fitting of the Retort-House. Engagement, Three years. Wages, £14 per month.
Apply, by letter only, with copies of Testimonials, stating age, if married or single, and present employment, to the CEARA GAS COMPANY, LIMITED, 9, Queen Street Place, CANNON STREET, E.C.

WANTED, a well-educated young Person as COKE CLERK in the Works Office of a Country Gas Company. One accustomed to Stores and Fittings Books preferred.
Wages to start 30s. per week, rising every two years to a Maximum of about £120 per annum.
Security to the amount of £200 in an approved Guarantee Office will be required.
Apply, by letter, to No. 1731, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

NEWTOWNARDS TOWN COMMISSIONERS.

WANTED, a second-hand Station GOVERNOR, with 5 to 7 inch Connections.
Full particulars to ALEX. WADDELL, Manager.

WANTED, a good second-hand Rotary EXHAUSTER, to pass 80,000 cubic feet per hour.
Lowest price and particulars to S. WHILE, 60, Queen Victoria Street, LONDON, E.C.

GAS-WORKS AND CHEMICAL PLANT FOR SALE.

CARBONIZING Plant at Mount Vernon, Glasgow, FOR SALE, consisting of 60 Retorts, with Condensers, Exhausters, and Scrubbers; also Benzol Recovery Plant. All complete and in good order; having only been in use a short time. Makers, Dempster and Sons, Elland.
To be sold by private treaty, in one lot, or separately, to suit purchasers.
Apply to REID BROTHERS, 67, St. Enoch Square, GLASGOW.

FOR SALE—A small Gas-Works, with Coal Business. Good opening for pushing Man.
Write to W. H. MORGAN, Consulting Engineer, GLOUCESTER.

FOR SALE—A Set of Condensers, with 6-inch Bye-Pass, &c., complete. A TOWER SCRUBBER, 16 feet high, 5 feet diameter, with 6-inch Bye-Pass and Connections complete. In first-class condition.
Apply to Mr. TAYLOR, Hurst Mills Company, Limited, ASHTON-UNDER-LYNE.

FOR SALE—One of Anderson's Patent ENGINES and EXHAUSTERS combined, to pass 5000 cubic feet of Gas per hour. In thorough order. Can be seen at work at the Gas-Works, Chichester, Sussex. Coming down to be replaced by one of greater capacity.
For further particulars apply to R. S. CHURCH, Secretary, Gas-Works, CHICHESTER.

FOR SALE—Four Purifiers, 16 ft. by 12 ft. by 8 ft. 9 in. deep inside, with 12-inch Centre-Valve (Walker's) and Connections. Practically equal to new. Would erect complete.
Also Four PURIFIERS 12 ft. by 6 ft. 9 in. by 8 ft. deep inside, with 10-inch Centre-Valve and Connections. Do.
Also One Cast-Iron SCRUBBER 40 ft. high by 10 ft. diameter.
Also One Cast-Iron SCRUBBER 24 ft. high by 10 ft. diameter.
Inquiries invited for various second-hand Gas Plant—Gasholders, Tanks, Purifiers, Washers, Exhausters, Station Meters, &c.
Apply to SAML. WHILE (late Ashmore and While), 60, Queen Victoria Street, LONDON, E.C.

TENDERS FOR TAR AND AMMONIACAL LIQUOR.

TENDERS are requested by the Directors of the Welch-Pool Gas Company, Limited, for the surplus TAR and LIQUOR for the next Twelve months.
The price to be net quarterly payments, delivered into Contractor's Tanks, at the Welch-Pool Gas-Works, into which a Siding runs.
Tenders to be delivered not later than July 20 inst., directed to
D. P. OWEN, Secretary.
Welch-Pool, July 4, 1889.

HEXHAM GAS COMPANY.

THE Directors of the Hexham Gas Company are prepared to receive TENDERS for PURIFIERS, to be erected at their Works.
Plans and specification may be seen at the Company's Office, Hexham, or upon application to Mr. J. Hepworth, C.E., Gas-Works, Carlisle.
Sealed tenders, endorsed "Tender for Purifiers," and addressed to the Chairman, Gas Company, Hexham, must be delivered on or before the 27th inst.
The Directors do not bind themselves to accept the lowest or any tender.
J. R. ELLISON, Manager.
Gas-Works, Hexham, July 11, 1889.

THE Directors of the Northfleet and Greenhithe Gas Company, Limited, invite OFFERS for the LOAN OF £500 on the Company's Bond, to be rendered on or before the 23rd inst.
Copies of the Directors' Report for the last half year will be sent on application to GEORGE KNIBBS, Secretary, Greenhithe, KENT.

BOROUGH OF HALIFAX.

THE Gas-Works Committee of the Halifax Corporation are prepared to receive TENDERS for the supply of Cast-Iron PIPES, for a period of Twelve months.
Specifications may be seen, and forms of tender and further information obtained, on application to Mr. Thomas Holgate, F.C.S., Gas-Works, Halifax.
Tenders, endorsed "Gas-Pipes," must be sent to the undersigned on or before the 20th of July inst.
By order,
KEIGHLEY WALTON, Town Clerk.
Town Hall, Halifax, July 4, 1889.

TO LIME MANUFACTURERS.

THE Corporation of Halifax are prepared to receive TENDERS for the supply of LIME required at their Gas-Works during the year ending the 30th of June, 1890.
Full particulars may be obtained on application to the Gas Engineer, Mr. T. Holgate, F.C.S, at the Gas-Works, Halifax.
Sealed tenders, endorsed "Lime," to be sent to the undersigned not later than Thursday, the 25th inst.
The lowest or any tender will not necessarily be accepted.
By order,
KEIGHLEY WALTON, Town Clerk.
Town Hall, Halifax, July 13, 1889.

YORKTOWN AND BLACKWATER GAS AND COKE COMPANY, LIMITED.

TENDERS are invited for the supply of about 600 tons of PELTON MAIN, or any other class of really good GAS COAL; to be delivered at the Blackwater Station, S.E.R., carriage paid, between the 1st of September, 1889, and the 1st of September, 1890, in quantities of about 60 tons, as ordered by the Secretary, giving Fourteen days' notice before expected at the Station.
Terms of payment, net cash within 21 days of arrival.
Sealed tenders, endorsed "Tender for Coal," forwarded to the Secretary, will be placed before the Directors about the 29th of July next.
Gas-Works, Yorktown, July 11, 1889.

BOROUGH OF BURTON-UPON-TRENT.

THE Gas Committee of the Burton-upon-Trent Corporation have FOR SALE Two TELESCOPIC GASHOLDERS, about 80 feet and 60 feet diameter respectively. They are now in use; but will shortly have to be removed to make room for Extensions.
Tenders will be received by the undersigned (from whom any further particulars may be obtained) until Saturday, the 27th inst.
The highest or any tender will not necessarily be accepted.
F. L. RAMSDEN,
Manager and Engineer.
Gas-Works, Burton-upon-Trent,
July 6, 1889.

TO TAR DISTILLERS AND OTHERS.

THE Directors of the Kingston-upon-Thames Gas Company are prepared to receive TENDERS for the purchase of the surplus TAR made at their Works, from the 24th day of July next, to the 30th day of June, 1890.
The probable quantity will be 180,000 gallons.
Full particulars may be obtained on application to Mr. Packham, Engineer, at the Works, Lower Ham Road.
Tenders to be sent in, addressed to the Chairman of the Directors, not later than Wednesday, July 24, 1889.
The Directors do not bind themselves to accept the highest or any tender.
By order,
J. A. FRICKER, Secretary.
July 12, 1889.

COUNTY BOROUGH OF SALFORD.
(GAS DEPARTMENT.)

SPENT OXIDE.

THE Gas Committee invite Tenders for the purchase of about 360 tons of SPENT OXIDE, now lying at their Regent Road and Liverpool Street Works.
Forms of tender and all particulars may be obtained on application to the Engineer, Gas Offices, Bloom Street, Salford.
Sealed Tenders, endorsed "Tender for Spent Oxide," addressed to the Chairman of the Gas Committee, must be delivered at the Town Clerk's Office, before Three p.m., on the 18th inst.
By order,
SAML. BROWN, Town Clerk.
Town Hall, Salford, July 8, 1889.

LYTHAM GAS.

THE Commissioners of the Town of Lytham invite TENDERS as follows:—
1. For the supply and erection of a Wrought-Iron ANNULAR CONDENSER, with 12-inch Connections; a LIVESEY WASHER; and a LAYCOCK and CLAPHAM'S WASHER-SCRUBBER. Capacity, 300,000 cubic feet per day each.
2. For the supply and erection of about 180 feet of 12-inch Wrought-Iron FOUL MAINS, with Cast-Iron Irregulars and Valves.

Plans may be seen, and other particulars obtained, at the Office of Mr. Thomas Newbigging, C.E., 5, Norfolk Street, Manchester.
Tenders to reach the undersigned not later than Twelve o'clock Noon on the 25th inst.
The lowest or any tender not necessarily accepted.
CHAS. A. MYERS,
Clerk to the Commissioners.
Lytham, July 13, 1889.

BOROUGH OF MOSSLEY.

SPENT OXIDE.

THE Gas Committee of the Borough of Mossley invite TENDERS for the purchase and removal of about 160 tons of SPENT OXIDE.
Further particulars may be obtained from Mr. R. Merrell, the Manager.
The Committee do not bind themselves to accept the highest or any tender.
Sealed tenders, endorsed "Spent Oxide," to be sent to me not later than Tuesday, the 16th inst.
By order,
JOSEPH HYDE, Town Clerk.

DARWEN CORPORATION GAS-WORKS.

TO TAR DISTILLERS.

THE Gas Committee of the above Cor-poration are prepared to receive TENDERS for all the surplus TAR produced at these Works for One, Two, or Three years. The Tar will be delivered into Contractor's Tanks on the Railway.
Forms of tender and any further particulars may be obtained from T. Duxbury, Engineer, Gas-Works, Darwen.
Tenders, endorsed "Tar," to be delivered to me not later than Twelve noon, Monday, July 22, 1889,
CHAS. COSTEKER, Town Clerk.

WREXHAM GASLIGHT COMPANY.

TO TAR DISTILLERS, ETC.

THE Directors of the above Company invite TENDERS for the surplus TAR and AMMONIACAL LIQUOR produced at their Works for One Year, commencing on the 1st day of August next.
Quantity produced, about 350 and 550 tons per annum respectively.
Further information may be obtained upon application to the undersigned, to whom tenders must be sent not later than the 25th inst.
The Directors do not bind themselves to accept the highest or any other tender.
By order of the Board,
THOS. WALKER,
Secretary and Manager.
Wrexham, July 5, 1889.

CORPORATION OF BURNLEY.

TO COLLIERY PROPRIETORS AND OTHERS.

THE Gas Committee of the Corporation of Burnley are prepared to receive TENDERS for One, Two, or Three years, for the supply of CANNEL COAL. The quantity required will be about 2400 tons per annum; and must be delivered in such monthly quantities as the Gas Manager of the Corporation may from time to time require.
The Cannel must be of good quality, dry, and as free as possible from Sulphur, Bats, Bind, Refuse, and Dirt and must be delivered into the Waggons of the Corporation, at their Wharf on the Leeds and Liverpool Canal, adjoining the Gas-Works.
Any person or persons tendering may be required to send Samples of the Cannel offered at the quoted Prices before the Contract is let.
Tenders, sealed, specifying the description of the Cannel, and the pits at which it is to be raised, must be addressed to the Chairman of the Gas Committee, Town Clerk's Office, marked "Tender for Cannel," and posted not later than Wednesday, the 17th of July, 1889.
By order of the Committee,
WALTER SOUTHERN, Town Clerk.

MANCHESTER CORPORATION GAS-WORKS.

AMMONIACAL LIQUOR.

THE Gas Committee of the Corporation of Manchester are prepared to receive TENDERS for the Purchase and Removal of the AMMONIACAL LIQUOR to be produced at the Gaythorn, Rochdale Road, and Bradford Road Gas-Works during a period of Five or Seven Years, commencing at Noon on the 30th day of June, 1890.
The Committee do not bind themselves to accept the highest or any tender.
Sealed tenders, addressed to the Chairman of the Gas Committee, and endorsed "Tender for Ammoniacal Liquor," must be delivered at the Offices of the Gas Department, Town Hall, on or before Thursday, the 8th day of August prox.
Forms of tender and further particulars may be obtained on application, in writing only, to Mr. Charles Nickson, Superintendent of the Department. A deposit of One Guinea (which will be returned on receipt of the tender) must accompany each application for a tender form.
By order of the Gas Committee,
JOSEPH HERON, Town Clerk.
Town Hall, Manchester, July 5, 1889.

WANDSWORTH AND PUTNEY GASLIGHT AND COKE COMPANY.

NOTICE is hereby given that the ORDINARY GENERAL MEETING of the Proprietors of the above Company will be held at the Company's Offices, North Street, Wandsworth, on Thursday, the 8th of August next, at Five o'clock in the Evening precisely, for the purpose of a Declaration of a Dividend, and the transaction of the General Business of the Company.
The Transfer Books will be closed on and from the 26th of July till the 8th of August, both days inclusive.
By order of the Board,
W. CROMARTY, Secretary.
North Street, Wandsworth,
July 13, 1889.

Price 2s. per dozen, or 10s 6d. per 100, post free.

CONSPIRACY and Protection of Property Act. It is required, under a Penalty of FIVE POUNDS, that a Printed Copy of the 4th Section of this Act shall be posted up at all Gas-Works, in a conspicuous place, where the same may be conveniently read by the persons employed thereat.
Printed copies of this Section, in large type, on broad sheets, may be obtained of WALTER KING, 11, Bolt Court, FLEET STREET, E.C.
*** *The Act extends to Scotland and Ireland.*

TO INVENTORS AND PATENTEES.

MR. W. H. BENNETT having had considerable experience in matters connected with Gas, Water, and Sanitary Improvement, begs to say that he continues to assist Inventors in the perfection of their designs, and to obtain for them PROVISIONAL PROTECTION, whereby their Inventions may be secured for Twelve months; or LETTERS PATENT, which are granted for Fourteen Years.

Patents completed, or proceeded with at any stage, thereby rendering it unnecessary for persons resident in the country to visit London.

Patents procured for Foreign Countries.

Information as to cost, &c., supplied gratuitously upon application to the Advertiser, 22, Great George Street, WESTMINSTER.

ROYAL CORNWALL POLYTECHNIC SOCIETY.

THE FIFTY-SEVENTH ANNUAL EXHIBITION WILL OPEN AT THE POLYTECHNIC HALL, FALMOUTH, ON TUESDAY, SEPTEMBER 10, 1889.

MEDALS AND PRIZES Are offered in MECHANICS, FINE ARTS, PHOTOGRAPHY, NATURAL HISTORY, AND OTHER DEPARTMENTS.

SPECIAL EXHIBITIONS OF DOMESTIC LIGHTING.

Board of Trade Certificate granted protecting unpatented Inventions.

For Prize Lists, Entry Forms, and all information apply to the Secretary, EDWARD KITTO, F.R.M.S., The Observatory, Falmouth.

ROBERT MARSHALL, CANNEL COAL MERCHANT, 97 WELLINGTON STREET, GLASGOW.

Prices and Analysis of all the Scotch Cannels on application.

GAS AND WATER PIPES.

1¼ to 12 IN. BORE.

THOMAS ALLAN & SONS, Bon Lea Foundry, SOUTH STOCKTON-ON-TEES.

ALSO MANUFACTURERS OF SANITARY & RAIN-WATER PIPES, HOT WATER PIPES, STABLE FITTINGS, RANGES, STOVES, And GENERAL CASTINGS.

GLASGOW OFFICE: 24, GEORGE SQUARE.

Telegrams: "BONLEA, STOCKTON-ON-TEES." "SPRINGBANK, GLASGOW."

THE LANEMARK COAL Co., LTD., Now offer their superior GAS COALS

LANEMARK CANNEL.

Yield of Gas per ton . . 10,880 cub. ft.
Illuminating Power . . 29·21 candles.
Coke per ton . . . . 1266·96 lbs.

LANEMARK GAS COAL.

Yield of Gas per ton . . 11,379 cub. ft.
Illuminating Power . . 17·88 candles.
Coke per ton . . . . 1285·53 lbs.

LANEMARK GAS BRIQUETTES.

Yield of Gas per ton . . 10,734 cub. ft.
Illuminating Power . . 22·70 candles.
Coke per ton . . . . . 1320 lbs.

For Prices and Analyses, apply to LANEMARK COAL Co., Ltd., NEW CUMNOCK, N.B.

JAMES NEWTON & SONS, (Established 1820) FIRE-BRICK AND TILE MERCHANTS, Wholesale and for Exportation, FALCON DOCK, 78 AND 79, BANKSIDE, SOUTHWARK, LONDON, S.E.

DEPÔT for STOURBRIDGE AND NEWCASTLE FIRE-BRICKS, LUMPS, TILES and FIRE-CLAY, and every Article suitable for GAS AND WATER WORKS.

"TEST PAPERS" FOR GAS, ETC., PREPARED BY R. D. GIBBS, Summerfield Crescent, Birmingham.

VALUATION OF COAL FOR GAS MAKING, ETC.

Estimation of (1) Moisture, 1s.; (2) Volatile Matter, 1s.; (3) Coke, 1s.; (4) Permanent Gases, 2s. 6d.; (5) Ash, 1s.; (6) Ammonia Capacity, 2s.; (7) Carbon, 1s. 6d.; (8) Sulphur, 2s. 6d. 1, 2, and 3 = 2s. 6d.; 1, 3, and 4 = 4s. Complete Combustion, 10s. 6d.

Five Samples submitted at same time to secure above Rate.

Estimation of Ammoniacal Liquor, 2s. 6d.; Oxide, for Active Iron, 2s.; for Sulphur, 3s.

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THOMAS ILLINGWORTH, NORTH DEAN CHEMICAL WORKS, Near HALIFAX, *MANUFACTURER OF SULPHURIC ACID* OF EXTRA QUALITY FOR MAKING WHITE SULPHATE OF AMMONIA.

TAR, LIQUOR, AND SPENT OXIDE Purchased for Cash against Delivery.

GAS COAL.

POPE & PEARSON, LTD., have now the authority of several of the most eminent Gas Engineers of London in stating that their Coal yields in practical working over 10,000 cubic feet of gas, with an illuminating power of 16 candles; or by the standard burners now used by the London Gas Companies, an illuminating power equal to 17¼ candles.

One ton yields 12¼ cwt. of good coke.

This Coal can be shipped from Hull, Goole, Liverpool, Morecambe, and Barrow.

For further particulars apply to POPE AND PEARSON, LIMITED, West Riding and Silkstone Collieries, near LEEDS.

THE "SILVER" LIGHT.

CHANDLER'S PATENT.

SUITABLE FOR EVERY FORM OF LIGHTING.

A beautiful white light from ordinary Gas. Silent, steady, and economical.

PACKED IN BOX 9s., SUBJECT.

S. CHANDLER & SONS, Central Works, Kennington Oval, S.E.

TROTTER, HAINES, & CORBETT, BRETTELLS' ESTATE FIRE-CLAY & BRICK WORKS, STOURBRIDGE.

Manufacturers of GAS-RETORTS, GLASSHOUSE FURNACE & BLAST-FURNACE BRICKS, LUMPS, TILES, and every description of FIRE-BRICK, Proprietors of BEST GLASSHOUSE POT & CRUCIBLE CLAYS. SHIPMENTS PROMPTLY AND CAREFULLY EXECUTED.

MARQUIS OF LOTHIAN'S NEWBATTLE CANNEL.

QUOTATIONS ON APPLICATION TO MR. JOHN MORISON, NEWBATTLE COLLIERIES, DALKEITH, N.B.

UNEQUALLED.

Gas Companies are solicited to try Samples of the MIRFIELD BLACK BED GAS COAL.

Prices and Analysis on application.

MIRFIELD (GAS-COAL) COLLIERY COMPY. MIRFIELD, NORMANTON.

THOMAS TURTON AND SONS, LIMITED, SHEAF AND SPRING WORKS, SHEFFIELD, MANUFACTURERS OF FILES OF BEST QUALITY FOR ENGINEERS. STEEL OF ALL DESCRIPTIONS.

SCREW STOCKS, TAPS AND DIES, SPANNERS, RATCHET BRACES, LIFTING-JACKS, ANVILS, VICES, AND ENGINEERS' TOOLS GENERALLY.

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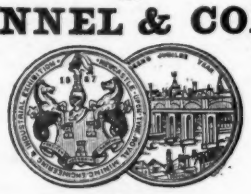
Awarded HIGHEST MEDAL and DIPLOMA at the Newcastle-on-Tyne Royal Mining and Industrial Exhibition, 1887, for CANNEL & COAL.



TYNE BOGHEAD CANNEL.

Yield of Gas per ton . . . . . 13,155 cub. ft
Illuminating Power . . . . . 38·22 candles
Coke per ton . . . . . 1,301·88 lbs.

EAST PONTOP GAS COAL.

Yield of Gas per ton . . . . . 10,500 cub. ft.
Illuminating Power . . . . . 16·3 candles.
Coke . . . . . 70 per cent.

For Prices and complete Analysis, apply to

YOUNG, DANCE, & CO., COAL OWNERS, NEWCASTLE-ON-TYNE, Or E. FOSTER & CO., 21, John St., Adelphi, LONDON, W.C.

THE ONLY RELIABLE

DRY CENTRE-VALVE.

WORKING ONE, TWO, THREE, OR FOUR PURIFIERS ON AT THE TIME.

ALSO MADE FOR TWO OR THREE PURIFIERS.

No Springing. No Leakage. No Foul Gas passed in Changing. Special Facility for Blowing the Air out of the Fresh Box before putting in Action, without driving it forward into the Holders.

Write for Prospectus.

ALSO DOUBLE-ACTION DOUBLE-FACED GAS & WATER VALVES.

F. WECK, 86, NEW STREET, BIRMINGHAM.

JAMES OAKES & CO.,

ALFRETON IRON-WORKS, DERBYSHIRE,
AND
WENLOCK IRON WHARF, 21 & 22, WHARF ROAD,
CITY ROAD, LONDON, N.,

Manufacture and keep in Stock at their Works (also large stock in London)
PIPES and CONNECTIONS, 1¼ to 48 inches in diameter; and make and erect to order RETORTS, PURIFIERS, and TANKS, with or without planed joints, COLUMNS, GIRDERS, SPECIAL CASTINGS, &c., required by Gas, Water, Railway, Telegraph, Chemical, Colliery, and other Companies.

NOTE.—Makers of HORSLEY'S PATENT SYPHONS. These are cast in one piece, without Chaplets; doing away with bolts, nuts, and covers and rendering leakage impossible.

IMPROVED RETORT SETTING.

W. G. WALLER & Co.,

RETORT SETTERS & CONTRACTORS,

Having had much experience in the Setting of Retorts, beg to call the attention of Gas Engineers and Managers to their Improved System of Setting Retorts and Tar-Furnaces.

Contractors for Building Shafts, Tanks, Retort Benches, and all other Buildings connected with Gas-Works.

Estimates on application.

The Poplars, Waddon, Croydon, Surrey.

CAST-IRON PIPES

FOR GAS AND WATER.

VALVES

FOR GAS, WATER, AND STEAM.

TELEGRAMS: "PIPES GLASGOW."

WM. MACLEOD & CO.,

56, ROBERTSON STREET, GLASGOW.

PRICE'S PATENT COKE & COAL BARROW

effecting a great saving of time, labour, and expense.

For particulars, price &c., apply to Mr. E. PRICE, Inventor and Patentee, Gas-Works, Hampton Wick, MIDDLESEX.

Prices are Reduced.

FIRE-BRICKS. ✣ ✣ FIRE-CLAY.

JAMES WHITE & CO.,

Albert Oil-Works,

WIDNES, LANCASHIRE.

Sole Proprietors of the Largest and Purest Beds of Fire-Clay in England.

FOR GAS FURNACES our GANNISTER and SILICA FIRE-BRICKS are acknowledged to be the best and most durable in the market.

GANNISTER and SILICA FIRE-CLAY guaranteed of the Purest and Finest Quality.

ANALYSIS AND REFERENCES ON APPLICATION.

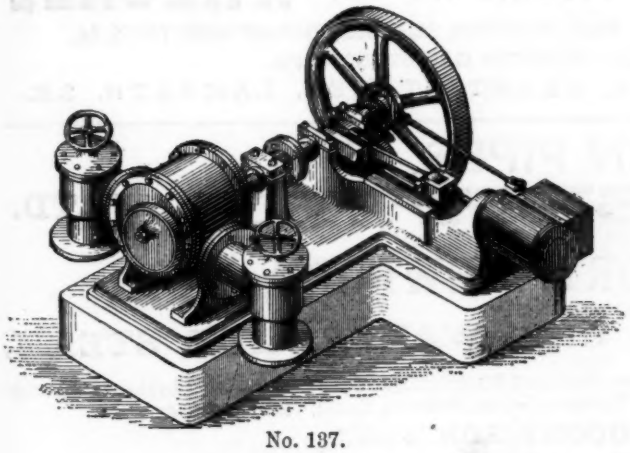
G. WALLER & Co.'s NEW PATENT GAS EXHAUSTER.

MADE WITH 4, 3, OR 2 BLADES.

In use at, or on order for, over 120 *Works, equal to* 6,840,000 *Cubic Feet per Hour.*

Oldest Makers of Beale Exhausters for over 300 Works and 25,600,000 cubic feet per hour.

1,000 to 250,000 CUBIC FEET PER HOUR WITH OR WITHOUT ENGINE COMBINED.



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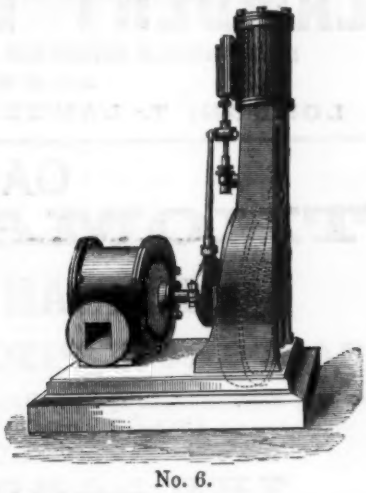

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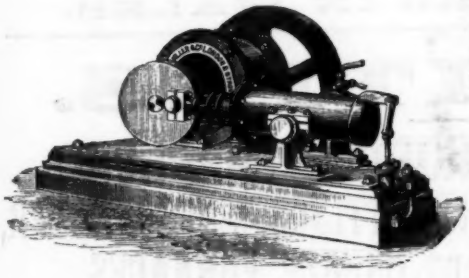


No. 5.

No. 137.—Horizontal Combined Engine and Exhauster.
No. 6.—Vertical ,, for small space.
No. 5.—Oscillating ,, for small works.

BYE-PASS VALVES.

Disc, Rack, and Screw Valves, Compensating Governors (For Steam Throttle Valves),

Tar, Liquor, and Water Pumps, Hydraulic Main Valves, Coke-Breaking Machines.

SEE PREVIOUS ADVERTISEMENTS. ILLUSTRATED CATALOGUE ON APPLICATION.

Phœnix Engineering Works, Park Street, Southwark, London, S.E.,

NEAR SOUTHWARK BRIDGE (FOUR MINUTES FROM HOLLAND STREET), AND AT

STROUD, GLOUCESTERSHIRE.

BRECKENRIDGE CANNEL,

OF KENTUCKY, U.S.A.

The undersigned, SOLE AGENTS for this celebrated Gas Cannel, now offer it for delivery at any port in

GREAT BRITAIN,

ON THE CONTINENT,

OR SOUTH AMERICA.

This Cannel ranks with the Australian Shale as an enricher of Coal Gas; One Gross Ton producing

15,000 Cubic Feet of 50-Candle Gas, & 26 Bushels of superior Marketable Coke.

FOR PRICES AND FURTHER PARTICULARS, APPLY TO

PERKINS & Co., SOLE AGENTS,

Cable Address: "Perkins New York." 228, PRODUCE EXCHANGE, NEW YORK.

G. J. EVESON,

GAS COAL AND CANNEL CONTRACTOR,

PATENTEE OF

A SPECIAL COMPOUND

FOR THE CURE OF STOPPED ASCENSION-PIPES,

A couple of charges of which will clear a stopped pipe, and an occasional charge keeps them clean, and also increases the make per ton and the illuminating power.

PRICE AND PARTICULARS ON APPLICATION.

Head Office: CORPORATION STREET, BIRMINGHAM.

LAMBERT BROS. ALPHA TUBE AND FITTING WORKS, WALSALL

MANUFACTURERS OF WROUGHT-IRON TUBES AND FITTINGS, BRASS GAS-FITTINGS, GAS-VALVES, STEAM AND WATER VALVES, &c.,

And of WARNER'S PATENT MARKET GAS STAND-PIPE.

LONDON: T. LAMBERT & SONS, SHORT STREET, LAMBETH, S.E.

CAST-IRON PIPES, ETC.

THOMAS SPITTLE, LTD.

[ESTABLISHED OVER 50 YEARS.]

CAMBRIAN FOUNDRY, NEWPORT, MON.,

MAKERS OF

CAST-IRON PIPES FOR GAS, WATER, AND STEAM.

ALSO

Retorts, Mouthpieces, Lamp-Posts, Hydraulic Mains, H-Pipes, Dip-Pipes, Buckstaves, Ash-pans, Sight-Holes, Syphons, Ascension-Pipes, Fire Doors and Frames, Fire-Bars, Hydrants, Valves, Purifiers, Tanks, Columns, &c., &c.

ALSO ALL WROUGHT-IRON WORK.

THE LARGEST MAKERS IN WALES.

SPECIALITIES.

THE "NUGENT" RECUPERATIVE RETORT SETTINGS and FURNACES.

"ROBUS" IMPROVED RETORT SETTINGS, with COKE, TAR, and BREEZE FURNACES.

THE ABOVE SETTINGS & FURNACES ARE PROVING EMINENTLY SATISFACTORY.

Every Particular, with Estimates, forwarded upon Application to

MESSRS. J. & H. ROBUS,

CONTRACTORS FOR THE ERECTION OF GAS & WATER WORKS,

37, WALBROOK, LONDON, E.C.

D. HULETT & CO.

Invite attention to the following Specialities:—

PATENT STREET LAMPS,

NO PUTTY OR OTHER MATERIALS ARE REQUIRED TO SECURE THE GLASS. PRICE 9s. 9d. EACH NET.

D. Hulett's Improved Service Cleanser, for the removal of Naphthalene and other obstructions in Service-Pipes. Price 70s. net.

IMPROVED HIGH-POWER LANTERNS; PRICES ON APPLICATION.

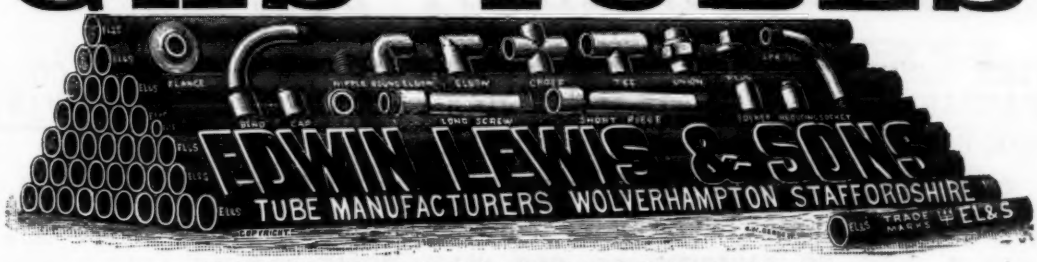
Patentees of Improved Wet and Dry Gas-Meters.

Makers of Pressure-Gauges, Gaseliers, and every kind of Gas-Fittings for the Trade.

SHOW-ROOM AND WORKS: **55 & 56, HIGH HOLBORN, LONDON.**

ESTABLISHED 1825.

GAS TUBES



MANUFACTURERS OF EVERY DESCRIPTION OF

IRON OR STEEL LAP-WELDED OR BUTT-WELDED TUBES

FOR ANY PURPOSE.

SIXTY PER CENT. ECONOMY IN GAS LIGHTING.

The Schülke Regenerative Lamp

FOR

DOMESTIC AND EXTERNAL LIGHTING.

The only Regenerative Lamp employing the Common Flat-Flame Burners.

Lamps giving 20-Candle power consume less than four feet of Gas per hour.

A PURE WHITE & PERFECTLY STEADY LIGHT,

NOT AFFECTED BY DRAUGHTS.

Suitable for any existing fittings (Brackets or Suspending).

Can be fixed in a few minutes.

May be seen at the Offices of the

SCHÜLKE GAS-LAMP Co.

LIMITED,

Room 446—11, QUEEN VICTORIA STREET,

LONDON, E.C.,

Where Price Lists and full particulars may be obtained.

JOSEPH CLIFF AND SONS,

THE ORIGINAL (ESTABLISHED 1795).

WORTLEY FIRE-BRICK WORKS,

NEAR LEEDS.

SPECIAL NOTICE.—Our Patent Machine-Made Retorts have now been thoroughly tested, and have proved themselves infinitely superior to those made by hand. At several large works it has been settled, beyond question, that, owing to the compactness and general excellence, more gas is sent to the gasholder from each ton of coal carbonized than is the case with hand-made Retorts.

AT THE PARIS EXHIBITION, 1878,

THREE MEDALS AND HONOURABLE MENTION

WERE AWARDED TO

JOSEPH CLIFF & SONS,

For their Various Exhibits, amongst which is a

SILVER MEDAL FOR THEIR PATENT MACHINE-MADE RETORTS AND FIRE-BRICKS,

Being the Highest Honour given for this Class.

London Wharf: No. 4, inside Great Northern Goods Station, King's Cross, N. Liverpool: Leeds Street.

BELL'S ASBESTOS AQUOL PAINT

TRADE MARK. BELL'S ASBESTOS.

IS MADE READY FOR USE.

IS FIRE RESISTING.
IS WASHABLE.
IS NON-POISONOUS.
IS MANUFACTURED IN ALL USEFUL COLOURS.
IS IMPERVIOUS TO HEAT, COLD, OR WATER.
IS WITHOUT SMELL.

No expensive Oil or Turpentine required.

WILL NEVER BLISTER.

HAS A COVERING CAPACITY 40 PER CENT. GREATER THAN LEAD PAINTS.

For Outside or Inside Work in any Climate.

Bell's Asbestos Aquol Paint is equally suitable for the finest decorative work as well as for general painting. It can be applied over or under any other paint, and, owing to its easy application, can be used with a large distemper brush; the SAVING THUS EFFECTED IN LABOUR BEING **50** PER CENT. OVER THAT OF LEAD PAINTS.

Bell's Asbestos Aquol Paint is susceptible of the most delicate treatment; and, owing to its perfect flatted surface, it brings up the varnish in a manner that no other paint can equal. ONE COAT OF VARNISH ON **Bell's Asbestos Aquol** IS EQUAL TO TWO COATS ON ORDINARY PAINT.

BELL'S ASBESTOS AQUOL PAINT is specially adapted for Private Houses, Exhibition Buildings, Ships, Churches, Asylums, School Boards, Railway Stations, and all work of Wood, Iron, Cement, Plaster, Stone, Brick, &c., &c.

Those who Study Economy and Protection from Fire should use only

BELL'S ASBESTOS AQUOL PAINT.

BELL'S ASBESTOS AQUOL PRIMING is made Ready for Use.
BELL'S ASBESTOS AQUOL PRIMING stops all suction of Wood, Cement, Plaster, &c.
BELL'S ASBESTOS AQUOL PRIMING should be applied to all New Work.

Suitable for Ceilings, Walls, and New Wood, and is very durable.

BELL'S ASBESTOS AQUOL KNOTTING, for Stopping Knots in New Work.

AN EXCELLENT CURE FOR DAMP WALLS.

Colour Cards and Price Lists on Application.

Supplied in Casks of 5 to 7 cwt., and Iron Drums of 28, 56, and 112 lbs., Sample Tins of 7 and 14 lbs.

Owing to its Covering Capacity, a SAVING IN FREIGHT of 40 per cent. is effected for a given surface.

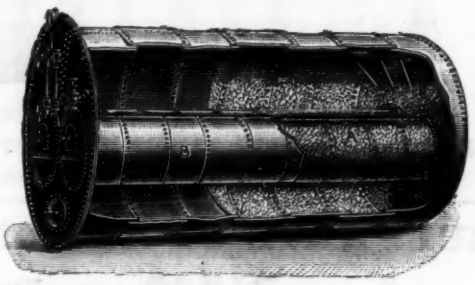
BELL'S ASBESTOS COMPANY, LIMITED,

SOUTHWARK, LONDON, S.E.

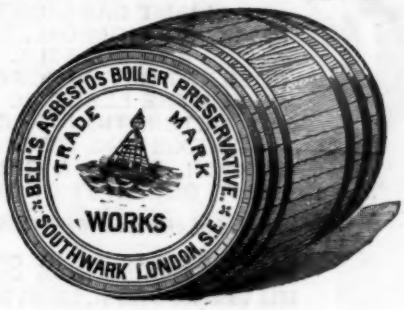
DEPÔTS—MANCHESTER: Cable Street, Blackfriars. LIVERPOOL: 2, Strand Street, James Street.
CARDIFF: West Bute Street. BIRMINGHAM: 7, John Bright Street. HULL: Humber Dock Basin.
GLASGOW: 35, Robertson Street. DUBLIN: 2, St. Andrew Street. BERLIN and BARCELONA.

BELL'S ASBESTOS BOILER PRESERVATIVE

Will remove Incrustation from Steam-Boilers of all kinds without chipping.



A shows Boiler Plates when incrusted.
B shows Boiler Plates when cleaned by this Composition.



Every Cask is sent out as above.

The action of this **BOILER PRESERVATIVE,** by absorbing the free oxygen that is in the water, **entirely checks pitting and corrosion.** It also disintegrates incrustation so immediately as to prevent its adhering to the plates; and the deposit falls to the bottom in a loose powder, which is easily swept out. By keeping boilers clean, a **great economy of fuel is effected,** and the danger of the plates burning is entirely obviated; thus avoiding the great risks which are inseparable from scaled plates, lengthening the life of a boiler, and **covering its own cost a hundredfold.** Whenever possible it should be used through Feed Pump or Injector, which it will also keep clear from incrustation. The small quantity required to effect its purpose makes this the most economical, and more than repays the higher price we charge for a fluid which, in the case of many other makers, is useless.

QUANTITY REQUIRED—A quarter of a pint weekly per horse power indicated; where the water is very bad rather more, or one pint for every 700 gallons of water evaporated.

BELL'S ASBESTOS CO., Ld.

DEPÔTS.
MANCHESTER: Cable St., Blackfriars.
LIVERPOOL: 2, Strand St., James St.
HULL: Humber Dock Basin.
DUBLIN, BERLIN.

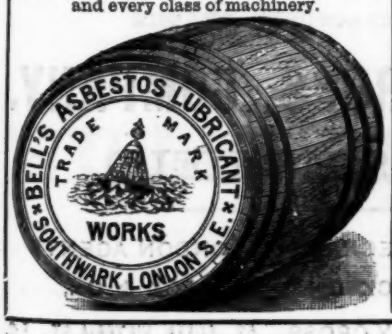
DEPÔTS.
BIRMINGHAM: 7, John Bright Street.
GLASGOW: 35, Robertson Street.
CARDIFF: West Bute Street.
And BARCELONA.

SOUTHWARK, LONDON, S.E.

BELLS ASBESTOS
YARN AND SOAPSTONE PACKING
Is the BEST LOCOMOTIVE PACKING made.

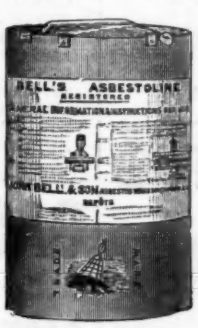
BELL'S
COMPOUND HYDRAULIC PACKING
Is specially suited for
Hydraulic Machinery, Accumulators, and Ammonia and all Pumps.

BELL'S ASBESTOS LUBRICANT
Is unequalled
For Steam-Engines & Cylinders, Gas-Engines, and every class of machinery.



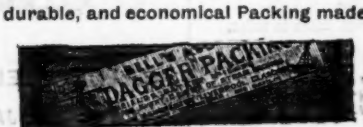
BELL'S ASBESTOLINE
The reputation of this Lubricant is based on the experience of thousands of users, which places it far in advance of those who rely only on mere laboratory tests.

ASBESTOLINE IS THE CHEAPEST, MOST EFFICIENT, CLEANEST, MOST INODOROUS AND SAFEST LUBRICANT.



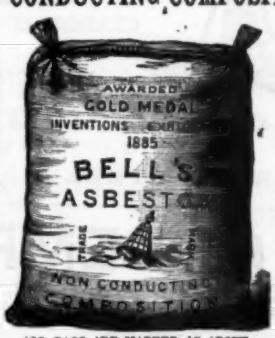
ASBESTOLINE HAS SAVED 90 PER CENT. OVER OIL.
Has been used for all purposes, AND BEATEN ALL OTHER LUBRICANTS IN ACTUAL WORK.

BELL'S ASBESTOS
"DAGGER" PACKING
Is unequalled for every kind of Marine and Land Engine, Steam-Pumps, &c., and has proved itself to be the most efficient, durable, and economical Packing made.



BELL'S ASBESTOS
NON-CONDUCTING COMPOSITION.

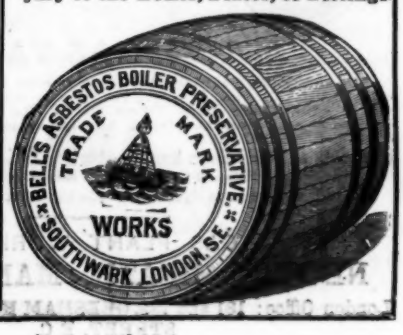
Will reduce loss by radiation, and saves 40 per cent. of fuel.
Saves its own cost in a few months.



Can be applied again after many years' service. Is sent out dry in bags; therefore cheaper than others sent out wet.

ALL BAGS ARE MARKED AS ABOVE.

BELL'S ASBESTOS
BOILER PRESERVATIVE
Will effectually keep Boilers clean, and remove any Incrustation, without injury to the Boiler, Plates, or Fittings.



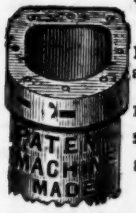
"THE METEOR."

NEW HIGH-POWER GAS-LAMP, WESTPHAL'S PATENT.
MOST INTENSE WHITE BRILLIANT GAS LIGHT.
MOST ECONOMICAL, SIMPLE, AND DURABLE.
DOES NOT GET OUT OF ORDER.
RIVALS THE ELECTRIC LIGHT.
NO ALTERATION REQUIRED TO EXISTING FITTINGS.
BURNER, BEING A CIRCULAR SLIT DOES NOT CHOKE UP.

PARTICULARS & PRICES POST FREE.

HENRY GREENE & SONS,
SOLE CONSIGNEES FOR GT. BRITAIN & COLONIES,
153 TO 155, CANNON STREET,
LONDON BRIDGE, E.C.

WILLIAM INGHAM & SONS,



WORTLEY FIRE-CLAY WORKS
Near LEEDS,

Have confidence in drawing the special attention of GAS ENGINEERS to the following advantages of their Retorts:—

1. Smooth interior, preventing Adhesion of Carbon.
2. They can be made in one piece up to 10 feet long.
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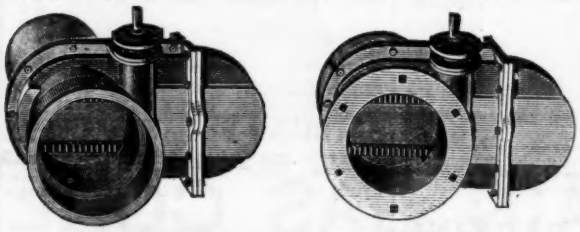

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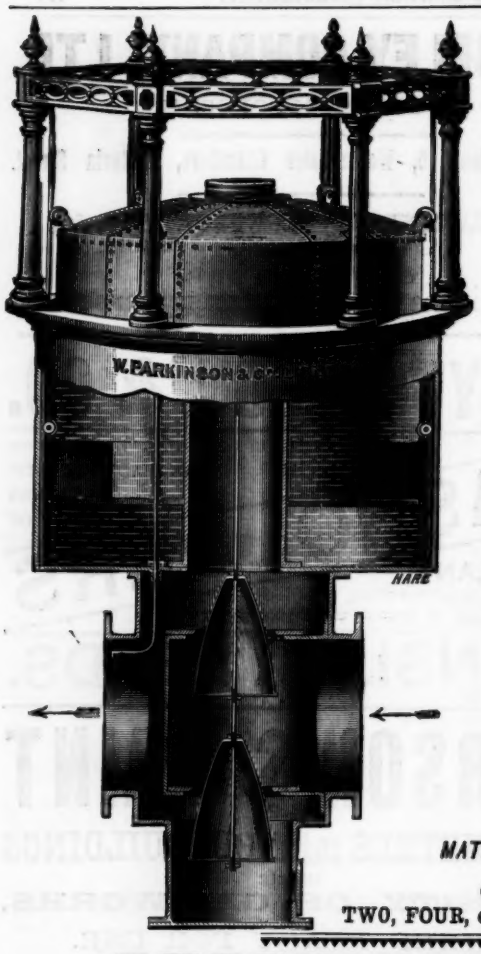

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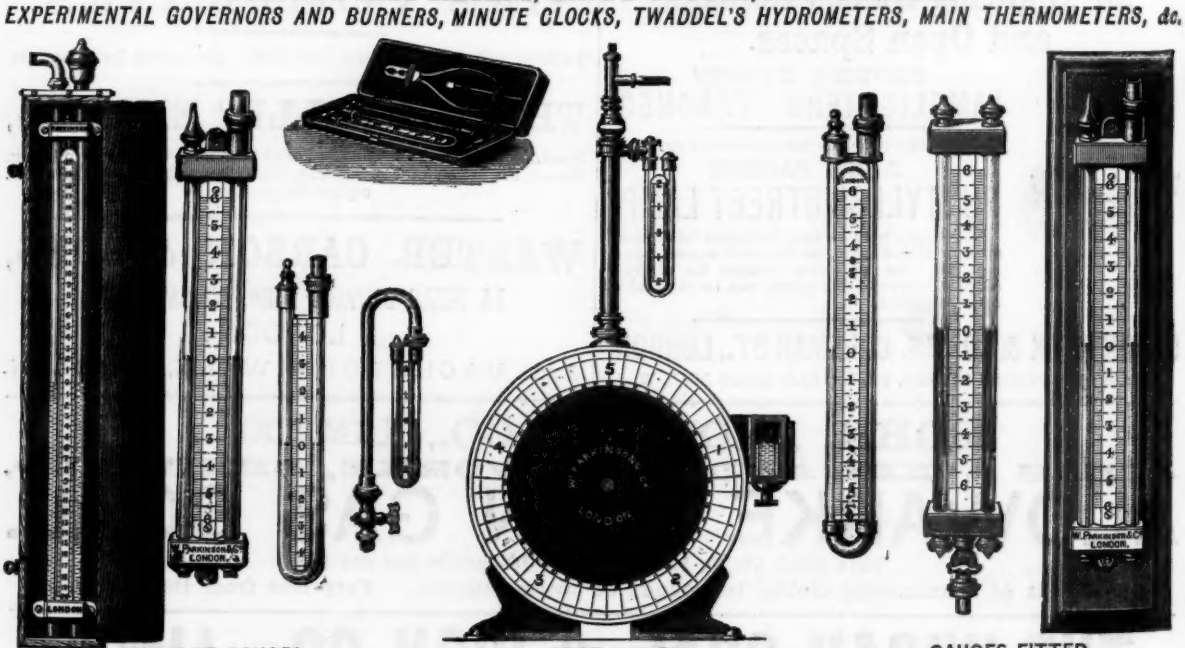

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